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**SECTION 011100
SUMMARY OF WORK**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Project description.
 - 2. Work sequence.
 - 3. Owner occupancy.
 - 4. Contractor's use of site and premises.

1.2 PROJECT DESCRIPTION

- A. Work of this Project is to remove an existing variant linear accelerator machine from an existing linear accelerator vault, and install a new linear accelerator, provided by Owner, into the existing space. Electrical, mechanical, and plumbing infrastructure upgrades and new equipment data conduits are also anticipated. Final design and installation requirements should be coordinated with the equipment manufacturer prior to installation.
- B. Work includes demolition, general construction, plumbing, HVAC, electrical, and site work.
- C. The Project will be constructed under a single prime contract.
- D. NOTE: ALL BIDDERS ARE TO REVIEW ALL BID DOCUMENTS TO ENSURE THEIR PROPOSAL INCLUDES ALL REQUIRED MATERIALS AND SERVICES.

1.3 WORK SEQUENCE

- A. Coordinate construction schedule and operations with the Owner and Project Manager.
- B. Schedule the Work to accommodate this requirement.

1.4 OWNER OCCUPANCY

- A. The Owner will occupy the site and premises during the entire period of construction for conduct of normal operations.
- B. Cooperate with the Owner to minimize conflict, and to facilitate Owner's operations.
- C. Schedule the Work to accommodate this requirement.

1.5 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Limit use of site and premises to allow for:
 - 1. Owner occupancy.
- B. Move any stored products under Contractor's control that interfere with the operations of the Owner.

- C. Assume full responsibility for protection and safekeeping of products under this Contract stored on site.
- D. Obtain and pay for use of any additional storage or work areas needed for operations.
- E. Coordinate use of site and premises with the Owner:
 - 1. Employee parking: In designated areas.
 - 2. Access to site and premises: It is a secured facility.
 - 3. Storage and staging areas: In designated areas.
 - 4. Transport materials and equipment to and from construction area along routes approved by Owner.
- F. Conform to Building Rules and Regulations.
- G. Confine operations to the designated construction area unless otherwise approved by Owner.
- H. If access to adjacent common or occupied spaces is required:
 - 1. Schedule operations with Owner in advance.
 - 2. Perform work after normal business hours or on weekends when directed by Owner.
- I. Do not interrupt building fire or life safety systems.
- J. Do not close or obstruct exits.
- K. Do not use or store hazardous or flammable materials on premises without Owner's approval; follow requirements of governing authorities having jurisdiction over the work.
- L. Prohibit the use of tobacco (smoking, vaping or chewing) is prohibited on the construction premises.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

**SECTION 012000
PRICE AND PAYMENT PROCEDURES**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Price and Contract Time.
- C. Change procedures.
- D. Correlation of Contractor submittals based on changes.
- E. Procedures for preparation and submittal of application for final payment.

1.2 SCHEDULE OF VALUES

- A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Owner's Representative for approval.
- B. Forms filled out by hand will not be accepted.
- C. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.
- D. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification Section. Identify site mobilization.
- E. Include in each line item, the amount of Allowances if applicable. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.
- F. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.
- G. Revise schedule to list approved Change Orders, with each Application For Payment.

1.3 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Owner's Representative for approval.
- C. Forms filled out by hand will not be accepted.
- D. For each item, provide a column for listing each of the following:
 - 1. Item Number.
 - 2. Description of work.
 - 3. Scheduled Values.

4. Previous Applications.
 5. Work in Place and Stored Materials under this Application.
 6. Authorized Change Orders.
 7. Total Completed and Stored to Date of Application.
 8. Percentage of Completion.
 9. Balance to Finish.
 10. Retainage.
- E. Execute certification by notarized signature of authorized officer.
 - F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
 - G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of Work.
 - H. Submit electronic copy of each Application for Payment.
 - I. Include the following with the application:
 1. Transmittal letter as specified for Submittals in Section 013300.
 2. Construction progress schedule, revised and current as specified in Section 013300.
 - J. When Owner's Representative requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.4 MODIFICATION PROCEDURES

- A. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in Contractor's employ or subcontractors of changes to the Contract Documents.
- B. For minor changes not involving an adjustment to the Contract Price or Contract Time, Owner's Representative will issue instructions directly to Contractor, in writing.
- C. For other required changes, Owner's Representative will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
 1. The document will describe the required changes and will designate method of determining any change in Contract Price or Contract Time.
 2. Promptly execute the change.
- D. For changes for which advance pricing is desired, Owner's Representative will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested

price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 3 days.

- E. Contractor may propose a change by submitting a request for change to Owner's Representative, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Price and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors. Document any requested substitutions in accordance with Section 016000.
- F. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
 - 1. For change requested by Owner's Representative for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
 - 2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Owner's Representative.
 - 3. For change ordered by Owner's Representative without a quotation from Contractor, the amount will be determined by Owner's Representative based on the Contractor's substantiation of costs as specified for Time and Material work.
- G. Substantiation of Costs: Provide full information required for evaluation.
 - 1. On request, provide following data:
 - a. Quantities of products, labor, and equipment.
 - b. Taxes, insurance, and bonds.
 - c. Overhead and profit.
 - d. Justification for any change in Contract Time.
 - e. Credit for deletions from Contract, similarly documented.
 - 2. Support each claim for additional costs with additional information:
 - a. Origin and date of claim.
 - b. Dates and times work was performed, and by whom.
 - c. Time records and wage rates paid.
 - d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
 - 3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.
- H. Execution of Change Orders: Owner's Representative will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

- I. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Price.
- J. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- K. Promptly enter changes in Project Record Documents.

1.5 APPLICATION FOR FINAL PAYMENT

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Price, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
 - 1. All closeout procedures specified in Section 017700.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

**SECTION 012500
SUBSTITUTION PROCEDURES**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Product Substitution Procedures.

1.2 GENERAL

- A. Definition: Proposal by Contractor to use manufacturer, product, material, or system different from one required in Contract Documents.
- B. Do not substitute Products unless a substitution request has been approved by Owner's Representative.
- C. Substitutions during Bidding.
- D. Owner's Representative will consider substitution requests within 30 days after award of Contract. After initial 30 day period, substitutions requests will be considered only due to non-availability of a specified Product through no fault of Contractor.
- E. In case of non-availability of a specified Product notify Owner's Representative in writing as soon as non-availability becomes apparent.

1.3 SUBSTITUTION REQUESTS

- A. Submit substitution requests on form provided by Owner's Representative.
- B. Document specified product and proposed substitution with complete data, including:
 - 1. Product identification, including name and address of manufacturer.
 - 2. Product description, performance and test data, and reference standards.
 - 3. Sample, if requested.
 - 4. Description of any anticipated effect that acceptance of proposed substitution will have on Progress Schedule, construction methods, or other items of Work.
 - 5. Description of any differences between specified product and proposed substitution.
 - 6. Difference in cost between specified product and proposed substitution.
- C. Burden of proof for substantiating compliance of proposed substitution with Contract Document requirements remains with Contractor.
- D. A request constitutes a representation that the Contractor:
 - 1. Has investigated the proposed Product and determined that it meets or exceeds the quality level of the specified Product.
 - 2. Will provide the same warranty for the substitution as for the specified Product.

3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
 4. Waives claims for additional costs or time extension that may subsequently become apparent.
 5. Will reimburse Owner for design services associated with re-approval by authorities or revisions to Contract Documents to accommodate the substitution.
- E. Substitutions will not be considered if:
1. They are indicated or implied on Shop Drawings or other submittals without submittal of a substitution request.
 2. Approval will require substantial revision of Contract Documents without additional compensation to Engineer.
- F. Submit electronically in Adobe PDF format.
- G. Owner's Representative will notify Contractor of approval or rejection of each Substitution Request within 14 calendar days .

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

**SECTION 012519
SUBSTITUTION REQUEST FORM**

DATE: _____

TO: _____

ATTENTION: _____

PROJECT: _____

We submit for your consideration the following product as a substitution for the specified product:

Section No.	Paragraph	Specified Product
_____	_____	_____

Proposed Substitution: _____

Reason for Substitution: _____

Product Data:

Attach complete technical data for both the specified product and the proposed substitution. Include information on changes to Contract Documents that the proposed substitution will require for its proper installation.

Samples:

Attached Will be furnished upon request

Does the substitution affect dimensions shown on Drawings?

No Yes (explain) _____

Effects of proposed substitution on other Work:

Differences between proposed substitution and specified Product:

Manufacturer's warranties of the proposed substitution are:

Same Different (explain) _____

Maintenance service and spare parts are available for proposed substitution from:

Previous installations where proposed substitution may be seen:

Project: _____ Project: _____

Owner: _____ Owner: _____

Engineer: _____ Engineer: _____

Date Installed: _____ Date Installed: _____

Cost savings to be realized by Owner, if proposed substitution is approved:

Change to Contract Time, if proposed substitution is approved:

No Change Add _____ days Deduct _____ days

Submittal constitutes a representation that [Contractor] [Construction Manager] has read and agrees to the provisions of Section 012500.

Submitted by [Contractor:] [Construction Manager:]

Signature

Firm

For Use by Owner's Representative:

Based on the information supplied by the [Contractor,] [Construction Manager,] the Owner's Representative has reviewed the proposed substitution on the basis of design concept of the Work and conformance with information given in Contract Documents.

Approved Approved as Noted Rejected

Submit Additional Information: _____

By: _____ Date: _____

**SECTION 012613
REQUESTS FOR INFORMATION**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Requests for Information (RFI's).
- B. Related Sections:
 - 1. Section 012500 - Substitution Procedures.
 - 2. Section 013300 - Submittal Procedures.
 - 3. Section 017700 - Closeout Procedures.

1.2 GENERAL

- A. Request for Information (RFI): Request from Contractor seeking interpretation or clarification of Contract Documents not involving Substitutions or changes to Contract Sum or Contract Time.
- B. RFI's constitute a request for information only.
- C. Do not submit RFI's:
 - 1. To request approval of Substitutions; refer to Section 012500.
 - 2. To request changes known to include changes to Contract Sum or Contract Time; refer to Section 012600.
 - 3. To request approval of submittals; refer to Section 013300.
 - 4. To submit Project Record Documents; refer to Section 017700.

1.3 SUBMITTAL

- A. Submit RFI's on Contractor's standard form.
- B. Include on each RFI:
 - 1. Name of Contractor.
 - 2. Project name.
 - 3. Date submitted.
 - 4. Sequential RFI number.
 - 5. Applicable Drawing sheet and detail numbers or Specification Section numbers.
 - 6. Recommendation or proposed solution.

- 7. Date when response information is required to avoid impact on Construction Schedule and Construction Cost.
- C. Review and sign RFI's submitted by Subcontractors, Sub-Subcontractors, or Suppliers prior to submittal to Owner's Representative.
- D. Maintain log of RFI's showing RFI number and current status of each RFI.
- E. When RFI's require submittal of drawings, follow submittal procedures specified for Shop Drawings in Section 013300.
- F. Submit electronically in Adobe PDF format.
- G. Allow minimum 7 days for Owner's Representative's review and response to each RFI.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

**SECTION 013100
PROJECT MANAGEMENT AND COORDINATION**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Project coordination.
 - 2. Coordination drawings.
 - 3. Project meetings.
- B. Related Sections:
 - 1. Section 017700 - Closeout Procedures.

1.2 PROJECT COORDINATION

- A. Submit required project submittals electronically in Adobe PDF format.
- B. Coordinate scheduling, submittals, and work of various Sections of specifications to assure efficient and orderly sequence of installation of interdependent construction elements.
- C. Verify that utility requirement characteristics of operating equipment are compatible with building utilities. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service such equipment.
- D. Coordinate space requirements and installation of mechanical and electrical items that are indicated diagrammatically on Drawings.
 - 1. Follow routing shown as closely as practical; place runs parallel with building lines.
 - 2. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and cleanup of work of separate Sections in preparation for Substantial Completion.
- G. After Owner occupancy, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents to minimize disruption of Owner's activities.

1.3 COORDINATION DRAWINGS

- A. Coordination Drawings:
 - 1. Prior to commencement of Work, prepare coordination drawings to define relationship of mechanical, plumbing, fire protection, and electrical components with beams, columns, ceilings and walls.

2. Include plans, elevations, sections, and details required to define relationships between components.
 3. Prepare drawings at 1/4 inch = 1'-0" scale for general layout and 3/8 inch = 1'-0" for plans and sections in congested areas including equipment spaces.
 4. Submit electronically in Adobe PDF format.
- B. Hold coordination meetings with trades providing mechanical, plumbing, fire protection, and electrical work.
 - C. Resolve conflicts between trades, prepare composite coordination drawings and obtain signatures on original composite coordination Drawings.
 - D. When conflicts cannot be resolved:
 1. Cease work in areas of conflict and request clarification prior to proceeding.
 2. Prepare drawings to define and to indicate proposed solution.
 3. Submit drawings for approval when actual measurements and analysis of Drawings and Project Manual indicate that various systems cannot be installed without significant deviation from intent of Contract Documents.
 - E. Submit original composite coordination drawings as part of Project Record Documents specified in Section 017700.

1.4 PROJECT MEETINGS

- A. Schedule and administer preconstruction conference, progress meetings, and pre-installation conferences.
- B. Make physical arrangements for meetings; notify involved parties at least 4 days in advance.
- C. Record significant proceedings and decisions at each meeting; reproduce and distribute copies to parties in attendance and others affected by proceedings and decisions made.

1.5 PRECONSTRUCTION CONFERENCE

- A. Schedule within 7 days after date of Notice to Proceed at Contractor's Project field office or other designated location.
- B. Attendance:
 1. Contractor.
 2. Owner.
 3. Architect and principal consultants.
 4. Major subcontractors and suppliers as Contractor deem appropriate.
 5. Representative of Testing Laboratory.
- C. Review and Discuss:

1. Relation and coordination of various parties, and responsible personnel for each party.
2. Use of premises, including office and storage areas, temporary controls, and security procedures.
3. Construction schedule and critical work sequencing.
4. Processing of:
 - a. Contract modifications.
 - b. Shop Drawings, Product Data, and Samples.
 - c. Applications for Payment.
 - d. Substitutions.
 - e. Requests for Information.
 - f. Other required submittals.
5. Adequacy of distribution of Contract Documents.
6. Procedures for maintaining contract closeout submittals.
7. Installation and removal of temporary facilities.
8. Notification procedures and extent of testing and inspection services.

1.6 PROGRESS MEETINGS

- A. Schedule weekly progress meetings.
- B. Location: Contractor's Project field office or other designated location.
- C. Attendance:
 1. Contractor.
 2. Owner.
 3. Architect and consultants as appropriate to agenda.
 4. Subcontractors and suppliers as appropriate to agenda.
 5. Others as appropriate to agenda.
- D. Review and Discuss:
 1. Work progress since previous meeting, including:
 - a. Field observations, deficiencies, conflicts, and problems.
 - b. Progress and completion date.
 - c. Corrective measures needed to maintain quality standards, progress, and completion date.

2. Status of:
 - a. Requests for information.
 - b. Submittals.
 - c. Contract modifications.
3. Coordination between various elements of Work.
4. Maintenance of Project Record Documents.

1.7 PRE-INSTALLATION CONFERENCES

- A. Where required in individual specification Section, convene a pre-installation conference at project site or other designated location.
- B. Require attendance of parties directly affecting or affected by work of the specific Section.
- C. Review conditions of installation, preparation and installation procedures, and coordination with related work.

1.8 PART 2 - PRODUCTS - NOT USED

1.9 PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 013216
CONSTRUCTION PROGRESS SCHEDULES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Construction progress schedule.
- B. Related Sections:
 - 1. Section 011100 - Summary of Work

1.2 FORMAT

- A. Prepare Progress Schedule as a horizontal bar chart with separate bar for each major portion of Work or operation, identifying first work day of each week. Prepare Progress Schedule on network analysis system using the critical path method.
- B. Sequence of Listings: The chronological order of the start of each item of Work.
- C. Scale and Spacing: To provide space for notations and revisions.
- D. Sheet Size: Multiples of 8-1/2 x 11 inches.

1.3 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification Section number.
- C. Identify work of logically grouped activities.
- D. Provide sub schedules for each phase of Work identified in Section 011100.
- E. Provide sub schedules to define critical portions of the entire Progress Schedule.
- F. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- G. Provide separate schedule of submittal dates for Shop Drawings, Product Data, and Samples, including:
 - 1. Dates reviewed submittals will be required from Owner's Representative.
 - 2. Decision dates for selection of finishes.
 - 3. Delivery dates for Owner furnished products.
- H. Revisions:
 - 1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.

2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.

I. Provide narrative report to define problem areas, anticipated delays, and impact on Progress Schedule. Report corrective action taken, or proposed, and its effect.

1.4 SUBMITTAL

A. Submit initial Progress Schedule within 7 days after date of Notice to Proceed. After review, resubmit required revised data within 5 days.

B. Submit electronically in Adobe PDF format.

1.5 DISTRIBUTION

A. Distribute copies of approved Progress Schedule to project site file, Subcontractors, suppliers, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in Progress Schedule.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

**SECTION 013300
SUBMITTAL PROCEDURES**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Submittal procedures.
 - 2. Proposed Products list.
 - 3. Submittal schedule.
 - 4. Shop Drawings.
 - 5. Product Data.
 - 6. Samples.
 - 7. Quality control submittals.
- B. Related Sections:
 - 1. Section 0140 00 - Quality Requirements.

1.2 SUBMITTAL PROCEDURES

- A. Number each submittal with Project Manual section number and a sequential number within each section. Number resubmittals with original number and an alphabetic suffix.
- B. Identify Project, Contractor, Subcontractor or supplier, pertinent Drawing sheet and detail numbers, and specification Section number, as appropriate.
- C. Submit all submittals listed under "Submittals for Review" simultaneously for each Product or Specification Section.
- D. Where multiple products function as an assembly, group submittals for all related Products into single submittal.
- E. Engineer will not review incomplete submittals.
- F. Apply Contractor's stamp, signed or initialed certifying that:
 - 1. Submittal was reviewed.
 - 2. Products, field dimensions, and adjacent construction have been verified.
 - 3. Information has been coordinated with requirements of Work and Contract Documents.
- G. Schedule submittals to expedite the Project, and deliver to Owner's Representative. Coordinate submittal of related items.
- H. For each submittal, allow 14 days for Owner's Representative's review, excluding delivery time to and from Contractor.

- I. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of completed Work.
- J. Revise and resubmit submittals when required; identify all changes made since previous submittal.
- K. Distribute copies of reviewed submittals to concerned parties and to Project Record Documents file. Instruct parties to promptly report any inability to comply with provisions.
- L. Engineering costs for additional reviews beyond two submittals (initial and resubmittal) will be billed to the General Contractor by the Owner's Representative at current hourly rates.

1.3 PROPOSED PRODUCTS LIST

- A. Within 7 days after date of Notice to Proceed, submit a complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.
- C. Submit electronically in Adobe PDF format.

1.4 SUBMITTAL SCHEDULE

- A. Within 7 days after date of Notice to Proceed, submit a submittal schedule showing all submittals proposed for project, including submittals listed as:
 - 1. Submittals for Review.
 - 2. Quality Control Submittals.
 - 3. Sustainable Design Submittals.
 - 4. Closeout Submittals.
- B. Include for each submittal:
 - 1. Specification section number.
 - 2. Description of submittal.
 - 3. Type of submittal.
 - 4. Anticipated submittal date.
 - 5. For submittals requiring Owner's Representative's review, date reviewed submittal will be required from Owner's Representative.
- C. Submit electronically in Adobe PDF format.

1.5 SHOP DRAWINGS

- A. Present information in clear and thorough manner.
- B. Identify details by reference to sheet and detail numbers or room number shown on Drawings.

- C. Reproductions of details contained in Contract Documents are not acceptable.
- D. Submit electronically in Adobe PDF format. Owner's Representative will return electronically in Adobe PDF format.

1.6 PRODUCT DATA

- A. Mark each copy to identify applicable products, models, options, and other data.
- B. Supplement manufacturers' standard data to provide information unique to this Project.
- C. Submit electronically in Adobe PDF format. Owner's Representative will return electronically in Adobe PDF format.

1.7 SAMPLES

- A. Submit samples to illustrate functional and aesthetic characteristics of Products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
- B. Where so indicated, submit samples of finishes from the full range of manufacturers' standard colors, textures, and patterns for Owner's Representative's selection.
- C. Include identification on each sample, with full Project information.
- D. Unless otherwise specified in individual specifications, submit two of each sample.
- E. Owner's Representative will notify Contractor of approval or rejection of samples, or of selection of color, texture, or pattern if full range is submitted.

1.8 QUALITY CONTROL SUBMITTALS

- A. Quality control submittals specified in Section 014000 are for information and do not require Engineer's responsive action except to require resubmission of incomplete or incorrect information.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

**SECTION 014000
QUALITY REQUIREMENTS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Mock-ups.
- B. Control of installation.
- C. Tolerances.
- D. Testing and inspection services.
- E. Manufacturers' field services.

1.2 RELATED REQUIREMENTS

- A. Section 013300 - Submittal procedures.
- B. Section 016000 - Product Requirements: Requirements for material and product quality.

1.3 REFERENCE STANDARDS

- A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008.
- B. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2011.
- C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2009.
- D. ASTM E329 - Standard Specification for Agencies Engaged Construction Inspection and/or Testing; 2011.
- E. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2009.

1.4 SUBMITTALS

- A. Design Data: Submit for Owner's Representative's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
- B. Test Reports: After each test/inspection, promptly submit two copies of report to Owner's Representative and to Contractor.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.

- e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Conformance with Contract Documents.
 - k. When requested by Owner's Representative, provide interpretation of results.
- C. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Owner's Representative, in quantities specified for Product Data.
- 1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- D. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- E. Manufacturer's Field Reports: Submit reports for Owner's Representative's benefit as contract administrator or for Owner.
- 1. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the Contract Documents.
- F. Erection Drawings: Submit drawings for Owner's Representative's benefit as contract administrator or for Owner.
- 1. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the Contract Documents.

1.5 TESTING AND INSPECTION AGENCIES

- A. Owner will employ services of an independent testing agency to perform certain specified testing; payment for cost of services will be derived from Owner's allowance specified in the contract documents; see applicable sections for description of services included in allowance.
- B. Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.
- C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- D. Contractor Employed Agency:
 - 1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, ASTM C1021, ASTM C1077, and ASTM C1093.

2. Laboratory: Authorized to operate in Texas.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in the sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Owner's Representative before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.2 MOCK-UPS

- A. Tests will be performed under provisions identified in this section and identified in the respective product specification sections. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- B. Accepted mock-ups shall be a comparison standard for the remaining Work.
- C. Where mock-up has been accepted by Owner's Representative and is specified in product specification sections to be removed, remove mock-up and clear area when directed to do so.

3.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Owner's Representative before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

3.4 TESTING AND INSPECTION

- A. See individual specification sections for testing required.
- B. Testing Agency Duties:

1. Test samples of mixes submitted by Contractor.
 2. Provide qualified personnel at site. Cooperate with Owner's Representative and Contractor in performance of services.
 3. Perform specified sampling and testing of products in accordance with specified standards.
 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 5. Promptly notify Owner's Representative and Contractor of observed irregularities or non-conformance of Work or products.
 6. Perform additional tests and inspections required by Owner's Representative.
 7. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:
1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency may not approve or accept any portion of the Work.
 3. Agency may not assume any duties of Contractor.
 4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:
1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 4. Notify Owner's Representative and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

- E. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Owner's Representative.
- F. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

3.5 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.6 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not conforming to specified requirements.
- B. If, in the opinion of Owner's Representative, it is not practical to remove and replace the Work, Owner's Representative will direct an appropriate remedy or adjust payment.

END OF SECTION

SECTION 014523
TESTING AND INSPECTION SERVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Laboratory selection and payment.
 - 2. Laboratory duties.
 - 3. Contractor's responsibilities.
- B. Related Sections: Individual specifications sections contain specific tests and inspections to be performed.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
 - 2. D3666 - Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials.
 - 3. D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
 - 4. E329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
 - 5. E543 - Standard Specification for Agencies Performing Nondestructive Testing.

1.3 QUALITY ASSURANCE

- A. Owner will employ and pay for services of an independent testing laboratory to perform specified testing and inspection.
- B. Contractor shall cooperate with the Testing Laboratory to facilitate performance of its work.

1.4 LABORATORY DUTIES

- A. Cooperate with ~~Architect~~Engineer and Contractor provide qualified personnel after due notice.
- B. Perform specified inspections, sampling, and testing of materials and methods of construction:
 - 1. Comply with specified standards.
 - 2. Ascertain compliance or noncompliance of materials with requirements of Contract Documents.

- C. Promptly notify ArchitectEngineer and Contractor of observed irregularities or deficiencies of Work or products.
- D. Promptly submit written report of each test and inspection; submit electronically in Adobe PDF format to ArchitectEngineer, Owner, and Contractor.
- E. Each report to include:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Testing Laboratory name, address, and telephone number.
 - 4. Name of Inspector and signature of individual in charge.
 - 5. Date and time of sampling or inspection.
 - 6. Record of temperature and weather conditions.
 - 7. Date of test.
 - 8. Identification of product and specification section.
 - 9. Location of sample or test in project.
 - 10. Type of inspection or test.
 - 11. Results of tests and compliance or noncompliance with Contract Documents.
 - 12. Interpretation of test results when requested by ArchitectEngineer or Contractor.
- F. Perform additional tests when required by ArchitectEngineer or Contractor.
- G. Laboratory is not authorized to:
 - 1. Release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Approve or accept any portion of work.
 - 3. Perform any duties of Contractor.

1.5 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with Laboratory personnel, provide access to Work, and to manufacturer's operations.
- B. When materials require testing prior to being incorporated into Work, secure and deliver to Laboratory adequate quantities of representative samples of materials proposed to be used.
- C. Furnish copies of product test reports as required.
- D. Furnish incidental labor and facilities:
 - 1. To provide access to work to be tested.

2. To obtain and handle samples at site or at source of product to be tested.
 3. To facilitate inspections and tests.
 4. For safe storage and curing of test samples.
- E. Notify Laboratory sufficiently in advance of operations to allow for Laboratory assignment of personnel and scheduling of tests.
 - F. When tests or inspections cannot be performed after such notice, reimburse Owner for Laboratory personnel and travel expenses incurred due to Contractor's negligence.
 - G. Make arrangements with Laboratory and pay for additional samples and tests required for Contractor's convenience.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

**SECTION 016000
PRODUCT REQUIREMENTS**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General product requirements.
- B. Transportation, handling, storage and protection.
- C. Product option requirements.
- D. Substitution limitations and procedures.
- E. Maintenance materials, including extra materials, spare parts, tools, and software.

1.2 RELATED REQUIREMENTS

- A. Document Instructions to Bidders: Product options and substitution procedures prior to bid date.
- B. Section 014000 - Quality Requirements: Product quality monitoring.

1.3 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 - PRODUCTS

2.1 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by the Contract Documents.
- B. Do not use products having any of the following characteristics:
 - 1. Made using or containing CFC's or HCFC's.
 - 2. Made of wood from newly cut old growth timber.

2.2 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.3 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 - EXECUTION

3.1 SUBSTITUTION PROCEDURES

- A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.
- B. Owner's Representative will consider requests for substitutions only within 15 days after date of Agreement.
- C. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
- D. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
- E. A request for substitution constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - 2. Will provide the same warranty for the substitution as for the specified product.
 - 3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension that may subsequently become apparent.
 - 5. Will reimburse Owner and Owner's Representative for review or redesign services associated with re-approval by authorities.
- F. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- G. Substitution Submittal Procedure:
 - 1. Bond: As directed by Owner's Representative, and as indicated on the drawings, and in accordance with the approved Mock-up.
 - 2. Mortar Joints: Concave.

3. Submit electronic PDF copy of request for substitution for consideration. Limit each request to one proposed substitution.
4. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
5. The Owner's Representative will notify Contractor in writing of decision to accept or reject request.

3.2 TRANSPORTATION AND HANDLING

- A. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- B. Transport and handle products in accordance with manufacturer's instructions.
- C. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- D. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- E. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- F. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.3 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- H. Prevent contact with material that may cause corrosion, discoloration, or staining.
- I. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- J. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

**SECTION 017329
CUTTING AND PATCHING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Requirements and limitations for cutting and patching of work.

B. Related sections:

1. Section 012500 - Substitution Procedures.

1.2 SUBMITTALS

A. Submit written request in advance of executing cutting or alteration that affects:

1. Work of Owner or separate contractor.
2. Structural integrity of project.
3. Integrity or effectiveness of weather exposed or moisture resistant elements or systems.
4. Efficiency, operational life, maintenance, or safety of operational elements.
5. Visual qualities of sight exposed elements.

B. Include in Request:

1. Identification of project.
2. Description of work affected.
3. Necessity for cutting or patching.
4. Effect of cutting or patching on work of Owner or separate contractor, or on structural, weatherproof, or visual integrity of project.
5. Description of proposed work:
 - a. Scope of cutting and patching.
 - b. Subcontractor and trades to execute work.
 - c. Products proposed to be used.
 - d. Extent of refinishing.
6. Alternate to cutting and patching.
7. Cost proposal, if applicable.
8. Written permission of any separate contractor whose work will be affected.

- C. If conditions of work or schedule necessitate a change of material from that originally installed, submit substitution request in accordance with Section 012500.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine existing conditions of work, including elements subject to movement or damage during cutting and patching.
- B. After uncovering work, examine conditions affecting installation of new products or performance of work.
- C. Provide protection for other portions of project.
- D. Provide protection from elements.

3.2 CUTTING AND PATCHING

- A. Execute cutting to include excavating, fitting, and patching of Work required to:
 - 1. Make several parts fit properly.
 - 2. Uncover work to provide for installation of ill-timed work.
 - 3. Remove and replace defective work.
 - 4. Remove and replace work not conforming to requirements of Contract Documents.
 - 5. Provide routine penetrations of nonstructural surfaces for installation of piping and electrical conduit.
- B. Execute fitting and adjustment of products to provide finished installation to comply with specified tolerances, and finishes.
- C. Execute cutting and demolition by methods that will prevent damage to other work, and will provide proper surfaces to receive installation of repairs and new work.
- D. Execute excavating and backfilling by methods that will prevent damage to other Work, and will prevent settlement.
- E. Employ original installer or fabricator to perform cutting and patching for:
 - 1. Weather exposed or moisture resistant elements.
 - 2. Sight exposed finished surfaces.
- F. Restore work that has been cut or removed; install new products to provide completed Work in accordance with requirements of Contract Documents.
- G. Refinish entire surfaces as necessary to provide an even finish:
 - 1. Continuous surfaces: To nearest intersections.

2. Assembly: Refinish entirely.

END OF SECTION

**SECTION 017700
CLOSEOUT PROCEDURES**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Closeout procedures.
 2. Final cleaning.
 3. Adjusting.
 4. Project record documents.
 5. Operation and maintenance data.
 6. Warranties.
 7. Spare parts and maintenance materials.
 8. Starting of systems.
 9. Demonstration and instructions.

1.2 CLOSEOUT PROCEDURES

- A. Final Inspection:
1. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with the Contract Documents and ready for Owner's Representative's inspection.
 2. If Owner's Representative performs reinspection due to failure of Work to comply with claims of status of completion made by Contractor, Owner will compensate Owner's Representative for such additional services and will deduct the amount of such compensation from final payment to Contractor.
- B. Submit final Application for Payment showing original Contract Sum, adjustments, previous payments and sum remaining due.
- C. Closeout Submittals:
1. Evidence of compliance with requirements of governing authorities.
 2. Certificate of Occupancy.
 3. Project Record Documents.
 4. Operation and Maintenance Data.
 5. Warranties.
 6. Keys and keying schedule.

7. Spare parts and maintenance materials.
8. Evidence of payment of Subcontractors and suppliers.
9. Final lien waiver.
10. Certificate of insurance for products and completed operations.
11. Consent of Surety to final payment.
12. Sustainable Design Submittals.
13. Hazardous Materials Statement(s).

D. Owner will occupy all of the building as specified in Section 011100.

1.3 FINAL CLEANING

- A. Execute final cleaning prior to final inspection.
- B. Clean surfaces exposed to view:
 1. Clean glass.
 2. Remove temporary labels, stains and foreign substances.
 3. Polish transparent and glossy surfaces.
 4. Vacuum carpeted surfaces; damp mop hard surface flooring.
- C. Clean equipment and fixtures to a sanitary condition.
- D. Clean or replace filters of operating equipment.
- E. Clean debris from roofs and drainage systems.
- F. Clean site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.4 ADJUSTING

- A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.5 PROJECT RECORD DOCUMENTS

- A. Maintain following record documents on site; record actual revisions to the Work:
 1. Drawings.
 2. Specifications.
 3. Addenda.
 4. Change Orders and other Modifications to the Contract.
 5. Reviewed Shop Drawings, Product Data, and Samples.

- 6. Material Safety Data Sheets.
 - B. Store Record Documents separate from documents used for construction.
 - C. Record information concurrent with construction progress.
 - D. Make entries neatly and accurately.
 - E. Label each set or volume with title "PROJECT RECORD DOCUMENTS", project title, and description of contents.
 - 1. Organize contents according to Project Manual Table of Contents.
 - 2. Provide Table of Contents for each volume.
 - F. Drawings: Mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish floor datum.
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 4. Field changes of dimension and detail.
 - 5. Details not on original Drawings.
 - G. Specifications: Mark each Product section description of actual Products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and Modifications.
 - H. Shop Drawings: Mark each item to record actual construction including:
 - 1. Field changes of dimension and detail.
 - 2. Details not on original Shop Drawings.
 - I. Submit electronically in Adobe PDF format.
- 1.6 OPERATION AND MAINTENANCE DATA
- A. Identify as "OPERATION AND MAINTENANCE INSTRUCTIONS" and title of project.
 - B. Contents:
 - 1. Directory: List names, addresses, and telephone numbers of Owner's Representative, Contractor, Subcontractors, and major equipment suppliers.

2. Operation and maintenance instructions: Arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
3. Project documents and certificates including:
 - a. Shop drawings and product data.
 - b. HVAC balance reports.
 - c. Certificates.
 - d. Copies of warranties and bonds.

C. Submittal:

1. Submit electronically in Adobe PDF format at least 15 days prior to final inspection.
2. Owner's Representative will notify Contractor of any required revisions after final inspection.
3. Revise content of documents as required prior to final submittal.
4. Submit revised documents electronically in Adobe PDF format within 10 days after final inspection.

1.7 WARRANTIES

- A. Execute and assemble documents from Subcontractors, suppliers, and manufacturers.
- B. Include Table of Contents.
- C. Submit electronically in Adobe PDF format along with final Application for Payment.
- D. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period.

1.8 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification Sections.
- B. Deliver to Project site in location as directed; obtain receipt prior to final payment.

1.9 STARTING OF SYSTEMS

- A. Notify Owner and Owner's Representative at least seven days prior to startup of each system or piece of equipment.
- B. Prior to beginning startup verify that:
 - 1. Lubrication has been performed.
 - 2. Drive rotation, belt tension, control sequences, tests, meter readings, and electrical characteristics are within manufacturer's requirements.
 - 3. Utility connections and support components are complete and tested.
- C. Execute start-up under supervision of applicable manufacturer's representative or Contractor's personnel in accordance with manufacturers' instructions.
- D. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to startup, and to supervise placing equipment or system in operation.
- E. Submit written report that equipment or system has been properly installed and is functioning correctly.

1.10 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of Products to Owner's personnel two weeks prior to date of Substantial Completion.
- B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- C. Utilize Operation and Maintenance Manuals as basis for instruction. Review contents of manual with Owners' personnel in detail to explain all aspects of operation and maintenance.
- D. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed upon times, at equipment location.
- E. Prepare and insert additional data in Operation and Maintenance Manuals when need for additional data becomes apparent during instruction.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

**SECTION 220010
BASIC PLUMBING REQUIREMENTS**

PART 1 - GENERAL

1.1 GENERAL PROVISIONS AND SUPPLEMENTAL GENERAL PROVISIONS

- A. The "General Conditions" and "Supplementary Conditions" are by reference made a part of this section and shall apply to each and every heading as though included herein.
- B. In the event of conflict, the requirements of the "General Conditions" and "Supplementary Conditions" will take precedence over these "General Requirements".

1.2 GENERAL

- A. The Contractor shall provide all plans, labor, equipment, appliances and materials, and shall perform all operations in connection with the installation of the plumbing work in accordance with the Specifications, applicable drawings, and the conditions specified above.
- B. Contractor shall provide all equipment required and usually furnished in connection with such work and systems whether or not specifically mentioned or specifically indicated on the drawings.

1.3 INSPECTION OF THE SITE

- A. The Contractor shall visit the site, verifying all existing items indicated on drawings and/or specified, and familiarize himself with the existing work conditions, hazards, grades, actual formations, soil conditions, and local requirements. The submission of bids shall be deemed evidence of such visits.
- B. All proposals shall take these existing conditions into consideration, and the lack of specific information on the drawings shall not relieve the Contractor of any responsibility.
- C. The trade furnishing the equipment shall be responsible for notifying the Contractor prior to ordering it, in the event that equipment specified and/or reviewed is incompatible with this requirement.

1.4 PERMITS, UTILITY CONNECTIONS, AND INSPECTIONS

- A. Refer to other sections of the specifications for construction phasing and time increments.
- B. The Contractor shall obtain and pay for all required utility connections, impact fees, utility extensions and/or relocations and shall pay all costs and inspection fees for all work included herein.

1.5 APPLICABLE CODES AND STANDARDS

- A. The installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards, which are made a part of the Specifications, except as may be hereinafter modified in these Specifications and associated drawings.
- B. Latest edition of the National Fire Protection Association Standards (NFPA):
 - 1. NFPA No. 70 National Electrical Code

2. NFPA No. 101 Safety to Life from Fire in Buildings and Structures
 3. NFPA No. 255 Test of Surface Burning Characteristics of Building Materials
- C. United States of America Standards Institute (ASA) Standards:
1. A40.8 National Plumbing Code
 2. B31.1 & B31.1a Code for Pressure Piping
- D. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Codes.
- E. American Society of Testing and Material (ASTM): All applicable manuals and standards.
- F. American Water Works Association (AWWA): All applicable manuals and standards.
- G. National Electrical Manufacturer's Association (NEMA): All applicable manuals and standards.
- H. City and State Building Codes.
- I. State of Texas Occupational Safety Act: Applicable safety standards.
- J. Occupational Safety and Health Act (OSHA).
- K. State of Texas Energy Conservation Construction Code.
- L. All work shall be in accordance with all regulations and requirements of the State of Texas Architectural Barriers Act (TAS).
- M. Texas Department of Health (TDH) Hospital Licensing Standards.
- N. Refer to Specifications sections hereinafter bound for additional codes and standards.
- O. All materials and workmanship shall comply with all applicable state and national codes, specifications, and industry standards. All material shall be listed by the Underwriter's Laboratories, Inc., as conforming to its standards and so labeled in every case where such a standard has been established for the particular type of material in question.
- P. All equipment provided and all installation methods shall meet all applicable requirements of the Fort Worth Energy Code (IECC 2015 with Fort Worth Amendments).
- Q. The Contract Documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by other specifications of the Contract Documents, providing no work or fabrication of materials has been accomplished in a manner of non-compliance. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations.

1.6 CONTRACT DOCUMENTS

- A. These specifications are accompanied by drawings of the building and details of the installations indicating the locations of equipment, piping, ductwork, outlets, switch controls, circuits, lines, etc. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.
- B. If the Contractor deems any departures from the drawings necessary, details of such departures and the reasons therefore shall be submitted to the Architect for review. No departures shall be made without prior written acceptance.
- C. There are intricacies of construction that are impractical to specify or indicate in detail; however, in such cases the current rules of good practice and applicable specifications shall govern.
- D. It is the Contractor's responsibility to properly use all information found on the Civil, Architectural, Structural, Fire Protection, Plumbing, Mechanical and Electrical drawings where such information affects his work.
- E. All dimensional information related to new structures should be taken from the appropriate drawings. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the site.
- F. The interrelation of the specifications, the drawings, and the schedules is as follows: The specifications determine the nature and setting of the several materials, the drawings establish the quantities, dimensions and details, and the schedules give the performance characteristics.
- G. Should the drawings or specifications disagree within themselves, or with each other, the better quality of greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Architect in writing, shall be performed or furnished. Figures indicated on drawings govern scale measurements and large-scale details govern small-scale drawings.

1.7 SPACE AND EQUIPMENT ARRANGEMENT

- A. The size of fire protection, plumbing, mechanical, and electrical equipment indicated on the drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment he proposes to furnish will fit in the space. Shop drawings shall be prepared to indicate a suitable arrangement.
- B. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.
- C. Maintain all Code required clearances for equipment access.

1.8 FABRICATION DRAWINGS

- A. Contractor shall submit shop drawings whenever (1) equipment proposed varies in physical size and arrangement from that indicated on the drawings, thus causing rearrangement of equipment space, (2) where tight spaces require extreme coordination between ductwork, piping, conduit and other equipment, and (3) where called for elsewhere in these specifications.
- B. Contractor shall submit piping shop drawings for review by the Architect. Fabrication drawings shall be fully coordinated with ALL other trades and with existing conditions.

- C. All required shop drawings, except as hereinafter specified, shall be prepared at a scale of not less than 1/8 in. equal to 1 ft. for floor plans and 1/4 in. equal to 1 ft. for mechanical rooms.

1.9 SUPERVISION

- A. Each contractor shall keep a competent superintendent or foreman on the job at all times necessary for the timely and proper completion of the work.
- B. It shall be the responsibility of each superintendent to study all drawings and familiarize himself with the work to be done by other trades. He shall coordinate this work with other trades, and before material is fabricated or installed, make sure that his work will not cause an interference that cannot be resolved without major changes to the drawings. If a conflict between trades arises that cannot be resolved at the jobsite, the matter shall be referred to the Architect for his ruling.

1.10 EXISTING FACILITIES

- A. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen, and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in-service maintenance of all plumbing, heating, air conditioning, and ventilating services for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, and remove all such temporary protection upon completion of the work. All barricades and safety devices shall be in compliance with OSHA.
- B. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.
- C. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.
- D. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, all Contractors shall remove and reinstall, in locations approved by the Architect, all devices required for the operation of the various systems installed in the existing construction. This is to include, but is not limited to, temperature control system devices, electrical switches, relays, fixtures, piping, conduit, etc.
- E. Outages of services, as required by the new installation, will be permitted only at a time approved by the Architect.

1.11 DEMOLITION AND RELOCATION

- A. The Contractor shall modify, remove and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition.

- B. All items that are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.
- C. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed and sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Architect. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas of facilities, which must remain in operation during the construction period, shall not be interrupted without prior specific approval of the Architect as hereinbefore specified.
- D. All equipment and materials indicated to be removed and not be re-used shall be disposed of by the Contractor.

1.12 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. The Contractor shall prepare, in triplicate for the Owner's Manual, complete sets of operating and maintenance instructions, system piping, valving, control and interlock diagrams, manuals, parts lists, etc., for each item of equipment. Include copies of all equipment warranties.
- B. In addition, the Contractor shall provide the services of a competent engineer or a technician acceptable to the Architect to instruct a representative of the Owner in the complete and detailed operation of all equipment and systems. These instructions shall be provided for a period of not less than 8 hours to fully accomplish the desired results. Upon completion of these instructions, a letter of release will be required, stating the dates of instruction and the personnel to whom instructions were given. The Contractor shall be responsible for proper maintenance until the instructions have been given to the Owner's maintenance personnel.

1.13 GUARANTEE

- A. All work and equipment shall be guaranteed for a period of one year from the date of substantial completion.
- B. Guarantee shall be for all labor and materials.
- C. Certain items for equipment shall have additional or extended warranties when so specified.

1.14 MATERIALS AND WORKMANSHIP

- A. All materials, unless otherwise specified, shall be of current U.S. manufacture, new, free from all defects, and of the best quality of their respective kinds. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall present a neat, workmanlike appearance. Materials, and/or equipment damaged in shipment, or otherwise damaged prior to installation, shall not be repaired at the job site, but shall be replaced with new materials and/or equipment.

- B. The responsibility for furnishing the proper equipment and/or material, and to see that it is installed as intended by the manufacturer rests entirely upon the Contractor, who shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

1.15 FLAME SPREAD PROPERTIES OF MATERIALS

- A. Materials and adhesives incorporated in this project shall conform to NFPA 255, latest edition. The classification shall not exceed No. 2, with the range of indices between 0 to 25 for these Classifications as listed in the Federal Specifications. Modifications shall be made to insulating materials, etc., as required to comply with the Federal Specification.

1.16 LARGE APPARATUS

- A. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

1.17 FLOOR AND CEILING PLATES

- A. Except as otherwise noted, provide chrome plated brass floor and ceiling plates around all pipes, conduits, ducts, etc., passing exposed through walls, floors, or ceilings, in any spaces, except under floor and attic spaces. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines that are insulated and positively secured to such pipe or insulation. Plates will not be required for piping where pipe sleeves extend 3/4 in. above finished floor. All equipment rooms are classified as finished areas. Round and rectangular ducts shall have plates made to fit accurately at all floor, wall and ceiling penetrations.

1.18 SLEEVES, INSERTS AND FASTENINGS

- A. Proper openings through floors, walls, roofs, etc., for the passage of piping, ductwork, etc., shall be provided. All penetrations must pass through sleeves except soil pipe installed under concrete slabs on fill. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Architect.
- B. Pipes passing through concrete or cinder walls and floor or other corrosive material shall be protected by a protective sheathing or wrapping or by sleeves, as required to meet the local code. Annular spaces between sleeves and pipes shall be filled or tightly caulked in an approved manner. Annular spaces between sleeves and pipes in fire-resistance-rated assemblies shall be filled or tightly caulked in accordance with the local code.
- C. The minimum clearance between horizontal penetrations including insulation where applicable, and sleeves shall be 1/4 in., except that the minimum clearance shall be 2 in. where piping contacts the ground. Sleeves through walls and partitions shall be installed flush with exposed surfaces. Sleeves through floors shall be extended 2 in. above finished floor.

- D. Above grade and dry location sleeves shall be constructed from 20 to 22 gauge galvanized steel. Sleeves passing through walls or floors on or below grade and/or moist areas such as mechanical rooms shall be constructed of galvanized steel Schedule 40 pipe and shall be designed with suitable flange in the center of the floor or wall to form a waterproof passage. After the pipes have been installed in the sleeves, void space around the pipe shall be sealed with "Link-Seal" modular wall and casing seals as manufactured by Thunderline Corporation.
- E. Suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction.
- F. Fastening of pipes, conduits, etc., in the building shall be as follows: To wood members - by wood screws; to masonry - by threaded metal inserts, metal expansion screws, or toggle bolts, whichever is appropriate for the particular type of masonry; to steel - machine screws or welding (when specifically permitted or directed), or bolts, and to concrete by suitable inserts anchored to reinforcing steel, and poured in place unless other means are acceptable for general use, and will only be permitted where specifically acceptable to the Architect.
- G. Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.
- H. Vermin Proofing: The open space around all ductwork, piping, etc., passing through the ground floor and/or exterior walls shall be sealed with a continuous bead of sealant.
- I. The space around piping, ductwork, etc., penetrating walls, ceilings and floors that define air plenums shall be sealed airtight in an acceptable manner. Ceiling plenums used for return air are considered air plenums.

1.19 ACCESS DOORS

- A. This Contractor shall provide wall or ceiling access doors for unrestricted access to all concealed shutoff or service valves, strainers, unions, flow switches, pressure reducing valves, control valves, air terminal units, fire and/or smoke dampers, and other items of concealed mechanical equipment. All access door locations are not shown on the drawings. It is the Contractor's responsibility to provide access doors at all locations required.
- B. Access doors mounted in painted surfaces shall be equal to Milcor (Inland-Ryerson Construction Products Company) manufacture, Style K for plastered surfaces and Style M or DW for non-plastered surfaces. The Style K doors shall be set so that the finished surface of the door is even with the finished surfaces of the adjacent finishes. Access doors mounted on tile surfaces shall be stainless steel materials. Access doors shall be minimum of 18 in. x 18 in. in size.

1.20 CONSTRUCTION REQUIREMENTS

- A. The Civil, Architectural, Structural, Fire Protection, Mechanical, Plumbing, and Electrical plans and specifications including the General Provisions, Supplemental General Provisions, and other pertinent documents issued by the Architect, are a part of these specifications and the accompanying fire protection drawings, and shall be complied with in every respect. All the above is included in the Contract Documents, and shall be examined by all bidders. Failure to comply shall not relieve the Contractor of responsibility or be used as a basis for additional compensation due to omission of architectural, structural and electrical details from the plumbing drawings.

- B. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction may be required for work indicated or specified in this section or work specified in other sections, it shall be the responsibility of the Contractor to provide same as well as to provide material and equipment usually furnished with such systems or required to complete the installation, whether mentioned or not.
- C. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation supplied by the manufacturer of the equipment to be installed and thereby to provide an integrated satisfactory operating installation.
- D. The plumbing and associated drawings are necessarily diagrammatic in character and cannot show every connection in detail or every pipe or equipment in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate pipe hangers shall be set before concrete is poured, and proper openings through floor, walls, beams, etc., shall be provided as hereinafter specified or as otherwise indicated or required. All work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- E. When the plumbing drawings do not give exact details as to the elevation of pipe, ducts, etc., physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Piping and duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner, and the plans do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas. Piping specified to be insulated shall be supported in a manner that will allow the insulation to be installed without gaps. Insulated piping in concealed areas shall be offset with fittings as necessary to permit installation of insulation. Bending of pipes or installing pipes in a strain in order to insulate will not be permitted.
- F. All oiling devices and all parts of equipment requiring adjustment shall be easily accessible. Equipment shall be so located and installed as to permit convenient and safe maintenance and future replacement. Piping, ductwork, valve stems, etc., shall not block service space.

1.21 PLUMBING SUBMITTALS

- A. Refer to the Conditions of the Contract (General and Supplementary) and Division 01 Section: "SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES" for submittal definitions, requirements, and procedures.
- B. Submittal of Shop Drawings, product data, and samples will be accepted only when submitted by The Contractor. Data submitted from Subcontractors and material suppliers directly to the Architect will not be processed.
- C. Submit Shop Drawings, product data, and samples on items indicated in the individual sections.

- D. Shop Drawings and submittal data shall not be used as requests or proposals for alternate equipment or materials. Refer to Item "Product Options and Substitutions" elsewhere in this section.
- E. THIRD PARTY CERTIFICATION: All Packaged equipment shall be independently Third Party labeled as a system for its intended use by a Nationally Recognized Testing Laboratory (NRTL) in accordance with OSHA Federal Regulations 29CFR1910.303 and .399, as well as NFPA Pamphlet #70, National Electric Code (NEC), Article 90-7.

1.22 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Refer to the Instructions to Bidders and the Division 01 Section "SUBSTITUTION PROCEDURES" for requirements in selecting products and requesting substitutions.
- B. Standards for Materials:
 - 1. These specifications indicate a standard for all materials incorporated into the work, with manufacturer's names and catalog numbers used to establish a grade and quality of materials and equipment. The manufacturer listed on the equipment schedules, or named first in the specifications, is the one on whose equipment the layout is based. Other named manufacturers must meet the indicated performance and space requirements.
 - 2. The "approved equal" clause used in these specifications is to permit the proposal of unnamed manufacturer's products for the work, and the Architect's decision concerning equal products is final.
 - 3. Considerations as to determination of equal products include, but are not limited to, the following:

	Materials	Physical size
	Workmanship	Weight
	Gauges of Materials	Appearance
	Available Local Service Personnel	Performance
	Previous successful installations	Capacity
	Delivery Schedules	Required Equipment Clearances

- C. Requests for substitutions for equipment, materials and apparatus listed in Division 22 Sections must be submitted in writing a **MINIMUM OF 10 DAYS** prior to the scheduled bid date. Such requests must be accompanied by complete data to permit proper evaluation.
- D. BIDS SHALL NOT BE BASED ON UN-APPROVED MATERIALS, EQUIPMENT, OR APPARATUS. UNAPPROVED MATERIAL, EQUIPMENT OR APPARATUS WILL NOT BE ACCEPTED.
- E. Should electrical, water, drain, natural gas, structural support, or other similar requirements for alternate equipment, whether named in the specifications or approved as a substitution, be different from requirements for the products used in laying out the project, such changes shall be the responsibility of the Contractor, and shall not result in extra charges to the Owner, Architect, or Engineer.

1.23 RECORD DOCUMENTS

- A. Refer to the Division 01 Section: "CLOSEOUT PROCEDURES" for requirements. The following paragraphs supplement the requirements of Division 01.
- B. Mark Drawings to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned for column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.
- C. Mark Specifications to indicate approved substitutions; Change Orders; actual equipment and materials used.

1.24 PAINTING

- A. Field painting of plumbing equipment, piping systems, etc., shall be accomplished under Division 09 of these specifications.
- B. Protection of Factory-applied Finishes:
 - 1. Factory-applied finishes on equipment and apparatus installed on the project shall be carefully protected.
 - 2. At the conclusion of the work, and prior to final acceptance of the project, equipment and apparatus shall be thoroughly cleaned of all construction dirt, oil and grease smears, temporary labels, debris, paint droppings, etc.
 - 3. Damaged factory finishes shall be restored to their original condition using procedures, materials and application techniques as set forth in Division 09 found elsewhere in these specifications.

1.25 CLEANING

- A. Refer to the Division 01 Section: "CLOSEOUT PROCEDURES" for general requirements for final cleaning.
- B. Refer to Division 23 Section: "TESTING, ADJUSTING, AND BALANCING" for requirements for cleaning filters, strainers, and mechanical systems prior to final acceptance.
- C. Name Plates:
 - 1. All nameplates shall be protected from damage during the construction process.
 - 2. At the conclusion of the work, the nameplates shall be carefully cleaned and left in a fully legible condition.
- D. Removal of Rubbish: Each Contractor is responsible for the timely removal of rubbish and trash generated by his work, such as empty cartons, containers, materials crates, etc. Particular attention is called to residue that may present a potential tripping or injury hazard.

1.26 MOTORS AND DRIVES

A. Motors:

1. General: Motors shall be U/L-approved, with copper windings, and with a minimum Service Factor of 1.15. The nominal capacity shall exceed the brake horse-power requirements at duty schedules.
2. Motors 1/2 HP and smaller shall be 120-volt, single-phase with internal overload protection.
3. Motors 3/4 HP and larger shall be 208/230 or 460 -volt, 3-phase, unless scheduled or noted otherwise, and shall have thermal over-load cutouts in each phase as recommended by the motor manufacturer.
4. Motors shall be as manufactured by Century, General Electric, US Motors, Wagner, Westinghouse, or approved equal.

B. Drives:

1. Belts drives shall be rated for 150% of motor-rated horsepower.
2. Drive assemblies up to two (2) belts shall have adjustable motor sheaves with the mid-point of the adjustment range at the RPM required for the specified performance.
3. On drive assemblies with 3 or more belts, provide fixed motor sheaves for the specified RPM. Provide and install up to 2 pulley changes as necessary to achieve the required air quantities.
4. All multiple-belt drives shall be factory-marked-matched sets.

C. Specific requirements:

1. Provide high-efficiency motors for the following:
 - a. Pumps, as scheduled.
2. Efficiency ranges shall be as follows:

	Nominal HP	Minimum Efficiency	Premium Efficiency
	3	86.5	89.5
	5	87.5	89.5
	7.5	88.5	91.7
	10	89.5	91.7
	15	91.0	92.4
	20	91.0	93.0
	25	91.7	93.6
	30	92.4	93.6
	40	93.0	94.1
	50, 60, 75	93.0, 93.6, 94.1	94.5, 95.0, 95.4
	100	94.1	95.4

3. Motor efficiency certification shall be included with Product Submittal Data in accordance with Division 01 of these specifications.
4. Variable Speed (Frequency) AC Drives:
 - a. Where scheduled on the plans, provide and install variable speed (frequency) AC drives for motors.
 - b. Variable speed (frequency) AC drives shall be as described in Section 238965 - MOTOR CONTROLLERS - of these Specifications.
5. Motor Starters and Controllers:
 - a. Motor starters and controllers for fans, pumps, air-handling units, compressors, etc., which are not provided as an integral part of a factory-assembled package, shall be provided under Division 23 of the specifications. Refer to Section 238965 "MOTOR CONTROLLERS."

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

- A. The manufacturer's published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufacturer's materials or equipment, unless otherwise indicated. The Contractor shall promptly notify the Architect in writing of any conflict between the requirements of the Contract Documents and the manufacturer's directions and shall obtain the Architect's instructions before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer's directions or such instructions from the Architect, he shall bear all costs arising in connection with the deficiencies.
- B. The Contractor shall not receive material or equipment at the jobsite until there is suitable space provided to properly protect equipment from rust, drip, humidity, and dust damage.
- C. Capacities shall be not less than those indicated but shall be such that no component or system becomes inoperative or is damaged because of start-up or other overload conditions.
- D. Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriter's Laboratories, Inc., or constructed and/or tested in accordance with the standards of the American Society of Mechanical Engineers, the Contractor shall submit proof that the items furnished under these sections of the specifications conform to such requirements. The ASME stamp will be acceptable as sufficient evidence that the items conform to the respective requirements.
- E. Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Observation.

- F. Standard factory finish will be acceptable on equipment specified by model number; otherwise surfaces of ferrous metal shall be given a rust-inhibiting coating. The treatment shall withstand 200 hours in salt-spray fog test, in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking, and no signs of rust creepage beyond 1/8 in. on either side of the scratch mark. Where rust-inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable, unless a specific coating is specified, except that coal tar or asphalt type coatings will not be acceptable, unless so stated for a specific item. Where steel is specified to be hot-dip galvanized, mill-galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-6215.
- G. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys and other rotating parts located so that any person can come in close proximity thereto, shall be fully enclosed or properly guarded.
- H. The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Architect of any discrepancy before performing any work. Adjustments to the work required, in order to facilitate a coordinated installation, shall be made at no additional cost to the Owner.

2.2 PROTECTION

- A. The Contractor shall at all times take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of the work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the incomplete building with tarpaulins or other protective covering. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.
- B. Take particular care not to damage the building structure in performing work. All finished floors, steel treads, and workmen or their tools and equipment shall cover finished surfaces to prevent any damage during the construction of the building.
- C. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final observation must be cleaned of rust and repainted as specified elsewhere in these specifications.

2.3 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS

- A. Each trade, subcontractor and/or contractor must work in harmony with the various other trades, subcontractors, and/or contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole. Each trade, subcontractor, and/or contractor must pursue his work promptly and carefully as not to delay the general progress of the job. This Contractor shall work in harmony with contractors working under other contracts on the premises.

2.4 PRECEDENCE OF MATERIALS

- A. These specifications and the accompanying drawings are intended to cover systems which will not interfere with the structural design of the building, which will fit into the available space, and which will insure complete and satisfactory systems. Each Contractor shall be responsible for the proper fitting of his material and apparatus into the building.
- B. Each Contractor shall so harmonize his work with that of the other trades so that it may be installed in the most direct and workmanlike manner without hindering or handicapping the other trades. Piping interferences shall be handled by giving precedence to pipelines that require a stated grade for proper operation. Where space requirements conflict, the following order of precedence shall, in general, be observed:
 - 1. Building lines
 - 2. Structural members
 - 3. Drain piping
 - 4. Vent piping
 - 5. Condensate piping
 - 6. Refrigerant piping
 - 7. Supply ductwork
 - 8. Return ductwork
 - 9. Exhaust ductwork
 - 10. Chilled water and heating water piping
 - 11. Automatic Fire Protection Sprinkler Piping
 - 12. Domestic hot and cold water piping
 - 13. Electrical conduit

2.5 LOCATION OF OUTLETS IN ROOMS

- A. All fire protection, plumbing, acoustical tile, diffusers, grilles, registers, and other devices shall be referenced to coordinated, established data points and shall be located to present symmetrical arrangements with these points and to facilitate the proper arrangements of acoustical tile panels and other similar panels with respect to the mechanical and electrical outlets and devices. Those mechanical and electrical outlets shall be referenced to such features as wall and ceiling furrings, balanced border widths, masonry joints, etc. Outlets in acoustical tile shall occur symmetrically in tile joints or in the center of whole tiles. When locations of mechanical and electrical devices shown on the Architect's reflected ceiling plans need to be modified, the final determination of the exact location of each outlet and the arrangement to be followed shall be acceptable to the Architect.

- B. The drawings show diagrammatically the location of the various outlets and apparatus. Exact locations of these outlets and apparatus shall be determined by reference to the general plans and to all detail drawings, equipment drawings, roughing-in drawings, etc., by measurements at the building, and in cooperation with the other trades. The Architect reserves the right to make any reasonable change in location of any outlet or apparatus before installation, without additional cost to the Owner.
- C. The Contractor, by submitting a bid on this work, sets forth that he has the necessary technical training and ability, and that he will install his work in a satisfactory and workmanlike manner which is up to the best standards of the trade, complete, and in good working order. If any of the requirements of the drawings and specifications are impossible of performance, or if the installation, when made in accordance with such requirements, will not perform satisfactorily, he shall report it to the Architect for correction promptly after discovery of the discrepancy.

2.6 CONNECTIONS FOR OTHERS

- A. This Contractor shall rough-in for and make all gas, water, steam, sewer, etc., connections to all fixtures, equipment, machinery, etc., provided by others in accordance with detailed roughing-in drawings provided by the equipment suppliers, along with actual measurements of the equipment connections, or as detailed.
- B. After the equipment is set in place, this Contractor shall make all final connections and shall provide all required pipe, fittings, valves, traps, etc.
- C. Provide all air gap fittings where required. In each water line serving an item of equipment or piece of machinery, provide a shut-off valve. On each drain not provided with a trap, provide a suitable trap.
- D. All pipe fittings, valves, traps, etc., exposed in finished areas and connected to chrome-plated lines provided by others shall be chrome plated to match.

2.7 WALL HUNG CARRIERS

- A. Provide floor mounted carriers for all wall mounted fixtures. Refer to Architectural plans and confirm walls intended to conceal carriers are adequate in depth to provide necessary space and clearance to properly install the carriers.

PART 3 - INSTALLATION

3.1 INSTALLATION METHODS

- A. All pipes shall be concealed in pipe chases, walls, furred spaces, or above the ceiling, unless otherwise indicated.
- B. Piping may be run exposed in mechanical rooms, janitors' closets, or storage spaces, but only where necessary. All exposed piping shall be run in the neatest, most inconspicuous manner, and parallel or perpendicular to the building lines.
- C. All piping shall be adequately and properly supported from the building structure by means of hanger rods or clamps to walls as herein specified.

- D. Where limited space is available above the ceilings and below concrete beams or other deep projections, pipe and conduit shall be sleeved through the projection where it crosses, in a manner to provide maximum above-floor clearance. Sleeves shall be as specified or as required.
- E. All pipe, conduits, etc., shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All ducts, pipes and conduits run, exposed in machinery and equipment rooms, shall be installed parallel to the building plans, except as otherwise shown. Conduits in furred ceilings and in other concealed spaces may be run at angles to the construction but shall be neatly grouped and racked indicating good workmanship. All conduit and pipe openings shall be kept closed until the systems are closed with final connections.
- F. There shall be no pipe joints nearer than 12 in. to a wall, ceiling, or floor penetration, unless pipe joint is the welded type joint.
- G. The Contractor shall study all construction documents and carefully lay out all work in advance of fabrication and erection in order to meet the requirements of the extremely limited spaces. Where conflicts occur, the Contractor shall meet with all involved trades and the Architect and resolve the conflict, prior to erection of any work, in the area involved.

3.2 CUTTING AND PATCHING

- A. Cut and patch openings through walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction.
- B. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills at locations acceptable to the Architect. Impact-type equipment will not be used, except where specifically acceptable to the Architect. Openings in Precast concrete slabs for pipes, conduits, outlet boxes, etc., shall be core drilled or cast to exact size.
- C. All openings shall be restored to "as-new" condition under the appropriate Specification Section for the materials involved, and shall match remaining surrounding materials and/or finishes.
- D. Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Architect.
- E. All plumbing work in areas containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.
- F. No cutting, boring, or excavating, which will weaken the structure, shall be undertaken. NO STRUCTURAL MEMBER MAY BE CUT WITHOUT THE WRITTEN APPROVAL OF THE ARCHITECT.

3.3 ROOF PENETRATIONS

- A. Pipe and duct sleeves and flashings compatible with the roofing installation shall be provided for roof penetrations. Manufacturer of roofing materials shall approve methods and materials.
 - 1. Pitch pans are not acceptable.

3.4 ROOF PIPING SUPPORTS

- A. Provide adjustable height threaded rod assembly supports as manufactured by MAPA Products model MS-1/MS-1-E or equal for supporting roof mounted condensate drain piping for pipe up to 2 in. Supports shall consist of a reinforced nylon support base, clamped pipe support bracket, and an adjustable threaded rod height assembly. A neoprene pad shall be adhered to the base. Install per manufacturer's instructions. Coordinate exact locations of supports with contractor.

3.5 FABRICATION OF PIPE

- A. All the various piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Lines shall also be graded for proper drainage.
- B. Piping shall follow as closely as possible the routes shown on plans, but shall take into consideration conditions to be met at the site.
- C. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after approval has been obtained.
- D. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping, in connections, and in equipment to which lines are connected.
- E. All piping shall be clean when it is installed. Before installation it shall be checked, upended, swabbed, if necessary, and all rust or dirt from storage shall be removed. Pipe shall not be permitted to lie on the ground during storage. Pipe ends shall be sealed during storage.

3.6 IDENTIFICATION AND LABELING

- A. The Contractor shall make it possible for the personnel operating and maintaining the equipment and systems in this project to readily identify the various pieces of equipment, valves, piping, etc., by marking them.
- B. All items of mechanical and electrical equipment shall be identified by the attachment of engraved nameplates constructed from laminated phenolic plastic, at least 1/16 in. thick, 3-ply, with black surfaces and white core. Engraving shall be condensed gothic, at least 1/2 in. high, appropriately spaced. Nomenclature on the label shall include the name of the item, its mark number, area, space, or equipment served, and other pertinent information. Equipment to be labeled shall include, but not be limited to, the following:
 - 1. Miscellaneous similar and/or related items.
- C. The Contractor shall install identification tags to be affixed to those valves that have functions that are not obvious. For example, it would not be expected that valves at a pressure reducing station in a machine room would be tagged. The valve identification tags shall be brass discs, 2 in. in diameter. Each tag shall be attached to its valve with copper clad annealed iron wire or other approved material.

3.7 TESTS AND INSPECTIONS

- A. The Contractor shall, during the progress of the work and upon its completion, test his work and make all tests as required by the specifications, state, municipal and other authorities having jurisdiction of the work. Piping pressure tests shall be made before pipe is concealed or covered. Tests shall be made in the presence of authorities requiring tests. The Contractor shall pay all costs, inspection charges and fees required for the tests of his work.
- B. The Contractor shall provide all apparatus, temporary piping connection, etc., required for tests. The Contractor shall take all due precautions to prevent damage to the building or its contents incurred by such tests. The Contractor shall repair and make good at his own expense any damage caused by failures or leaks during the tests.
- C. Leaks, defects or deficiencies shall be repaired and/or replaced, and tests shall be repeated until the test requirements are complied with fully.
- D. All equipment shall be placed in operation and tested for proper automatic control before the final balancing of the system is started.
- E. All tests shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel, description, and extent of system tested, test condition, test results, specified results, and any other pertinent data. Data shall be delivered to the Architect.

3.8 COOPERATION AND CLEANUP

- A. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the job site in a clean and safe condition. At the end of each day's work, each trade shall properly store all of his tools, equipment and materials and shall clean his debris from the job. Upon the completion of the job, each trade shall immediately remove all of his tools, equipment, any surplus materials and all debris caused by his portion of the work.

3.9 CLEANING AND PAINTING

- A. All equipment, piping, ductwork, grills, insulation, etc., in finished areas furnished and installed by the Contractor shall be painted. Finished areas include mechanical rooms, boiler rooms, and outside the building as well as occupied areas inside the building. Final painting is to be done by the General Contractor. This Contractor shall thoroughly clean all part of materials and equipment of cement, plaster, and other materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Exposed metal work shall be carefully brushed down with steel brushes to remove rust and other spots and left smooth and clean.
- B. This Contractor shall thoroughly clean the finish on all parts of the materials and equipment with factory applied finishes. Exposed parts in equipment rooms, above crawl space slabs, and all other spaces except sealed chases and attics shall be thoroughly cleaned of cement, plaster and other materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. If the finish has been damaged, the Contractor shall re-paint to the satisfaction of the Architect.
- C. All canvas finishes shall be painted with one sizing coat if not already sized, containing a mildew resistant additive and Arabol adhesive prior to any other specified finish paint.

- D. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible during painting operation.

3.10 ELECTRICAL PROVISIONS OF PLUMBING WORK

- A. The extent of electrical provisions to be provided as plumbing work is indicated in other sections of the specifications, on the drawings and as further specified in this section.
- B. Starters, Controllers: In general, plumbing includes furnishing combination starters. Controllers are specifically included as electrical work when mounted in motor control centers. Electrical work includes installation, mounting and wiring of starters and controllers that are furnished as mechanical work. Free standing, large motor controllers shall be set in place, on pads, as plumbing work.
- C. Electrical heating equipment shall be furnished complete with internal or integral fusing and subdivision of loads to comply with the NEC.
- D. Wherever possible, match the elements of the electrical provisions of plumbing work with similar elements of the electrical work specified in electrical sections of the specifications.
- E. Standards:
 - 1. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards to definitions of terminology herein.
 - 2. Comply with National Electrical Code (NFPA No. 70) for installation requirements.
 - 3. Comply with National Electrical Contractors Association (NECA) "Standard of Installation".

3.11 TEMPORARY FACILITIES

- A. Unless noted otherwise in the Supplementary General Conditions; provide temporary facilities.

3.12 EQUIPMENT INSTALLATION REQUIREMENTS

- A. All plumbing equipment shall be furnished and installed complete and ready for use.

3.13 OWNER FURNISHED EQUIPMENT

- A. The Contractor's responsibility shall include receiving and installing all Owner-furnished equipment.

END OF SECTION

**SECTION 220529
PLUMBING SUPPORTS AND ANCHORS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Extent of supports and anchors required by this section is indicated on Drawings and/or specified in other Division 22 sections.
- B. Types of supports and anchors specified in this section include the following:
 - 1. Pipe and equipment hangers, supports, and anchors.
 - 2. Equipment bases.
- C. Supports and anchors furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 22 sections.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. Code Compliance: Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.
 - 2. MSS Standard Compliance:
 - a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.
 - b. Select and apply pipe hangers and supports, complying with MSS SP-69.
 - c. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
 - d. Terminology used in this section is defined in MSS SP-90.

1.3 SUBMITTALS

- A. Submit product data as required under provisions of Division 01 and Section 220010.
- B. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor.

PART 2 - PRODUCTS

2.1 HORIZONTAL-PIPING HANGERS AND SUPPORTS

- A. General: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.
- B. Adjustable Steel Clevis Hangers: MSS Type 1.
- C. Yoke Type Pipe Clamps: MSS Type 2.
- D. Steel Double Bolt Pipe Clamps: MSS Type 3.
- E. Steel Pipe Clamps: MSS Type 4.
- F. Pipe Hangers: MSS Type 5.
- G. Adjustable Swivel Pipe Rings: MSS Type 6.
- H. Adjustable Steel Band Hangers: MSS Type 7.
- I. Adjustable Band Hangers: MSS Type 9.
- J. Adjustable Swivel Rings, Band Type: MSS Type 10.
- K. Split Pipe Rings: MSS Type 11.
- L. Extension Split Pipe Clamps: MSS Type 12.
- M. U-Bolts: MSS Type 24.
- N. Clips: MSS Type 26.
- O. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:
 - 1. Plate: Unguided type.
 - 2. Plate: Guided type.
 - 3. Plate: Hold-down clamp type.
- P. Pipe Saddle Supports: MSS Type 36, including steel pipe base-support and cast-iron floor flange.
- Q. Pipe Stanchion Saddles: MSS Type 37, including steel pipe base support and cast-iron floor flange.
- R. Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast-iron floor flange.
- S. Single Pipe Rolls: MSS Type 41.

- T. Adjustable Roller Hangers: MSS Type 43.
- U. Pipe Roll Stands: MSS Type 44.
- V. Pipe Rolls and Plates: MSS Type 45.
- W. Adjustable Pipe Roll Stands: MSS Type 46.

2.2 VERTICAL-PIPING CLAMPS

- A. General: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.
- B. Two-Bolt Riser Clamps: MSS Type 8.
- C. Four-Bolt Riser Clamps: MSS Type 42.

2.3 HANGER-ROD ATTACHMENTS

- A. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.
- B. Steel Turnbuckles: MSS Type 13.
- C. Steel Clevises: MSS Type 14.
- D. Swivel Turnbuckles: MSS Type 15.
- E. Malleable Iron Sockets: MSS Type 16.
- F. Steel Weldless Eye Nuts: MSS Type 17.

2.4 BUILDING ATTACHMENTS

- A. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.
- B. Top Beam C-Clamps: MSS Type 19.
- C. Side Beam or Channel Clamps: MSS Type 20.
- D. Center Beam Clamps: MSS Type 21.
- E. Welded Beam Attachments: MSS Type 22.

- F. C-Clamps: MSS Type 23.
- G. Top Beam Clamps: MSS Type 25.
- H. Side Beam Clamps: MSS Type 27.
- I. Steel Beam Clamps W/Eye Nut: MSS Type 28.
- J. Linked Steel Clamps W/Eye Nut: MSS Type 29.
- K. Malleable Beam Clamps: MSS Type 30.
- L. Steel Brackets: One of the following for indicated loading:
 - 1. Light Duty: MSS Type 31, suspending 750 lbs. max.
 - 2. Medium Duty: MSS Type 32, suspending 1500 lbs. max.
 - 3. Heavy Duty: MSS Type 33, suspending 3000 lbs. max.
- M. Side Beam Brackets: MSS Type 34.
- N. Plate Lugs: MSS Type 57.
- O. Horizontal Travelers: MSS Type 58.

2.5 CONCRETE INSERTS

- A. Drill-In Spot Type: Steel, attached wedge, lock washer and nut. Size inserts to suit threaded hanger rod.
 - 1. Acceptable Manufacturers and Models:
 - a. Hilti "Kwik Bolt"
 - b. Ramset "Wedge Anchor"
 - c. Rawl "Stud"
- B. Continuous Channel Type: Steel, anchoring lugs, with channel nuts, rated for 2000 lbs. per foot minimum load. Size channel nut to suit threaded hanger rod.
 - 1. Acceptable Manufacturers and Models:
 - a. B-Line B22
 - b. Elcen 1150
 - c. Unistrut P3200

2.6 SADDLES AND SHIELDS

- A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

- B. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.
- C. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.
- D. Thermal Hanger Shields: Constructed of 360° insert of high density, 125-psi compressive strength, and water-proofed calcium silicate, encased in 360° sheet metal shield. Provide assembly of same thickness as adjoining insulation.
 - 1. Manufacturer: Subject to compliance with requirements, provide thermal hanger shields of one of the following:
 - a. Elcen Metal Products Co.
 - b. Pipe Shields, Inc.

2.7 SPRING HANGERS AND SUPPORTS

- A. General: Except as otherwise indicated, provide factory-fabricated spring hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select spring hangers and supports to suit pipe size and loading.
- B. Restraint Control Devices: MSS Type 47.
- C. Spring Cushion Hangers: MSS Type 48.
- D. Spring Cushion Roll Hangers: MSS Type 49.
- E. Spring Sway Braces: MSS Type 50.
- F. Variable Spring Hangers: MSS Type 51; preset to indicated load and limit variability factor to 25%.
- G. Variable Spring Base Supports: MSS Type 52; preset to indicated load and limit variability factor to 25%; include load flange.
- H. Variable Spring Trapeze Hangers: MSS Type 53; preset to indicated load and limit variability factor to 25%.
- I. Constant Supports: Provide one of the following types, selected to suit piping system. Include auxiliary stops for erection and hydrostatic test, and field load-adjustment capability.
 - 1. Horizontal Type: MSS Type 54.
 - 2. Vertical Type: MSS Type 55.
 - 3. Trapeze Type: MSS Type 56.

2.8 MANUFACTURERS OF HANGERS AND SUPPORTS

- A. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:

1. B-Line Systems Inc.
2. ITT Grinnell Corp.

2.9 MISCELLANEOUS MATERIALS

- A. Metal Framing: Provide products complying with NEMA STD ML 1.
- B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.
- C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.
- D. Auxiliary Steel: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.
- E. Pipe Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

2.10 ROOF EQUIPMENT SUPPORTS

- A. General: Construct roof equipment supports using minimum 18-ga galvanized steel with fully mitered and welded corners, 3 in. cant, internal bulkhead reinforcing, integral base plates, pressure treated wood nailer, and 18-ga galvanized steel counter flashing.
- B. Configuration: Construct of sizes as indicated, compensate for slope in roof so top of support is dead level.
- C. Manufacturer: Subject to compliance with requirements, provide roof equipment supports of one of the following:
 1. Pate Co.
 2. Thycurb Div.; Thybar Corp.

2.11 ROOF PIPING SUPPORTS

- A. Single run pipe and conduits 2-1/2 in. O.D. and less, shall have Type SS-8R or SS-8C as manufactured by Portable Pipe Hangers, Inc., or an approved equal, spaced at a maximum 8 ft. o.c. and installed on roof pads if required by Roofing Manufacturer. All conduits shall be held in place with clips on bars. Coordinate exact locations of supports with Roofing Contractor. Do not use wood blocking under supports.
- B. Provide adjustable height threaded rod assembly supports as manufactured by MAPA Products Model MS-1/MS-1-E or equal for supporting roof mounted condensate drain piping for pipe up to 2 in. Supports shall consist of a reinforced nylon support base, clamped pipe support bracket, and an adjustable threaded rod height assembly. A neoprene pad shall be adhered to the base. Install per manufacturer's instructions. Coordinate exact locations of supports with contractor.

- C. All refrigerant piping on the roof shall be supported with Pipe Pier model PP050 piping supports. Spacing of pipe supports shall not exceed 8 ft. for pipes up to 1-1/4 in. and 10 ft. on all other piping. Coordinate exact locations of supports with Roofing Contractor. Install piping supports per manufacturer's instructions. Pipe supports shall be constructed of 10 in. L x 4 in. W x 4 in. H closed cell, medium density black polyethylene foam with a 14 gauge channel strut adhesively bonded to the polyethylene foam. Roofing Contractor shall provide roofing material pads under all supports.

2.12 ROOF PENETRATION SYSTEMS

- A. General: Construct roof penetration systems utilizing the "Alumi-Flash" system by Portals Plus, Inc., or equal by Thy-Curb.
- B. Each roof penetration shall include a spun aluminum base ("High" size if required due to the existing roof construction and any insulation thickness) and an EPDM rubber cap. Each rubber cap shall have a pre-molded pipe opening and shall be selected based on the actual pipe or conduit size required at each location. Secure each rubber cap to each pipe or conduit with the manufacturer's recommended stainless steel gear clamp.
- C. Manufacturer: Subject to compliance with requirements, provide roof penetration systems of one of the following:
 - 1. Portals Plus, Inc. Ron Widby 800-774-5240
 - 2. Thycurb Div.; Thybar Corp. Jr. Gracia 972-416-6220

2.13 SLEEVES, INSETS AND FASTENINGS

- A. Pipes passing through concrete or cinder walls and floor or other corrosive material shall be protected by a protective sheathing or wrapping or by sleeves, as required to meet the local code. Annular spaces between sleeves and pipes shall be filled or tightly caulked in an approved manner. Annular spaces between sleeves and pipes in fire-resistance-rated assemblies shall be filled or tightly caulked in accordance with the local code.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.
- B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.3 INSTALLATION OF BUILDING ATTACHMENTS

- A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at all changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

- A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Install additional at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at all changes in direction of piping. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
- B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
- C. Support fire-water piping independently of other piping.
- D. Prevent electrolysis in support of copper tubing by use of hangers and supports that are copper plated, or by other recognized industry methods.
- E. Support and laterally brace vertical pipe runs at every floor level and at intervals not to exceed 20 ft. 0 in. Support vertical pipe with riser clamps installed below hubs, couplings or lugs welded to the pipe.
- F. Provisions for Movement:
 - 1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
 - 2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
 - 3. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.
- G. Insulated Piping: Comply with the following installation requirements.
 - 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.

2. Piping hangers shall be sized large enough to allow insulation to pass through. Hangers for piping 2-1/2 in. and greater shall be provided with pipe covering protection saddle, or high compressive strength insulation saddle. Hangers for piping 2 in. and less shall be provided with pipe covering shields. On cold or chilled water piping provide vapor barrier through hanger.
3. Do NOT utilize "pipe size" hangers with insulation placed over the pipe and hanger.

3.5 INSTALLATION OF ANCHORS

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.
- C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.
- D. Anchor spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.6 EQUIPMENT SUPPORTS

- A. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands.
- B. Furnish roof equipment supports to Contractor for installation as part of work of Division 07; not work of this section.

3.7 ADJUSTING AND CLEANING

- A. Hanger Adjustments: Adjust hangers so as to distribute loads equally on attachments.
- B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.
- C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

**SECTION 220716
PLUMBING PIPING INSULATION**

PART 1 - GENERAL

1.1 SUMMARY

- A. Extent of plumbing insulation required by this section is indicated on Drawings and schedules, and by requirements of this section.
- B. Types of mechanical insulation specified in this section include the following:
 - 1. Piping System Insulation:
 - a. Fiberglass.
 - b. Flexible Unicellular.
- C. Refer to Section 220529 - PLUMBING SUPPORTS AND ANCHORS for protection saddles, protection shields, and thermal hanger shields; not work of this section.
- D. Refer to Section 220553 - PLUMBING IDENTIFICATION for installation of identification devices for piping, ductwork, and equipment; not work of this section.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.
- C. Flame/Smoke Ratings: Provide composite mechanical (insulating material, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.
 - 1. Exception: Outdoor mechanical insulation may have flame-spread index of 75 and smoke developed index of 150.
 - 2. Exception: Industrial mechanical insulation that will not affect life safety egress of building may have flame-spread index of 75 and smoke developed index of 150.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

- B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - 1. Armacell.
 - 2. Manson.
 - 3. Knauf Fiber Glass.
 - 4. Johns Manville Products Corp.
 - 5. Owens-Corning Fiberglass Corp.

2.2 PIPING INSULATION MATERIALS

- A. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated.
- B. Flexible Unicellular Piping Insulation: ASTM C 534, Type I.
- C. Jackets for Piping Insulation: ASTM C 921, Type I (Vapor Barrier) for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installer's option.
 - 1. Encase pipe fittings insulation with one-piece pre-molded PVC fitting covers, fastened as per manufacturer's recommendations.
 - 2. Encase exterior piping insulation with aluminum jacket with weather-proof construction.
- D. Staples, Bands, Wires and Cement: As recommended by insulation manufacturer for applications indicated.
- E. Adhesives, Sealers and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

2.3 EQUIPMENT INSULATION MATERIALS

- A. Flexible Fiberglass Equipment Insulation: ASTM C 553, Type 1, Class B-4.
- B. Flexible Unicellular Equipment Insulation: ASTM C 534, Type II.
- C. Jacketing Material for Equipment Insulation: Provide pre-sized glass cloth jacketing material, not less than 7.8 ounces per square yard, or metal jacket at Installer's option, except as otherwise indicated.
- D. Equipment Insulation Compounds: Provide adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

1. Encase exterior equipment insulation with aluminum jacket with weatherproof construction, as specified.
- E. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors and stud pins as recommended by insulation manufacturer for applications indicated.

2.4 METAL PROTECTIVE JACKET

- A. Sheet aluminum: ASTM B209, 3003 alloy, H-14 temper, and 0.016 in. thick. Provide moisture barrier lining for service temperatures 60°F or less except where applied over a Type I or II jacket. Longitudinal lap shall be at least two in. wide.
- B. Stainless Steel: ASTM A-240, manufactured from T-304 prime grade Stainless Steels, supplied with a regular dull finish for reduced glare and 0.016 in. thick. These alloys shall be of a soft-annealed temper, for ease in fabrication. Jacketing shall be used for insulated piping, tanks, and vessels less than 8 ft. in diameter. Deep corrugated sheets shall be used for diameters greater than 8 ft. Roll jacketing shall be 3/16 in. corrugated.
- C. Fitting covers: Factory fabricated from not lighter than 0.020 in. thick type 3003 sheet aluminum.
- D. Bands: 3/4 in wide aluminum on maximum 18 in. centers.
- E. Provide metal jackets over insulation as follows:
1. All piping exposed to outdoor weather.
 2. Piping exposed in building within five (5) ft. of the floor that connect to sterilizers, kitchen and laundry equipment. Jackets may be applied with pop rivets. Provide aluminum angle ring escutcheons at wall, ceiling and floor penetrations.
 3. A two in. overlap is required at longitudinal and circumferential joints.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.
- B. Thickness of insulation shall be as recommended by the manufacturer for the temperatures and pipe sizes involved, and in accordance with standards of T.I.M.A.

3.2 PLUMBING PIPING SYSTEM INSULATION

- A. Insulation Omitted: Omit insulation on chrome-plated exposed piping (except for handicapped fixtures), air chambers, unions, strainers, check valves, balance cocks, flow regulators, drain lines from water coolers, drainage piping located in crawl spaces or tunnels, buried piping, fire protection piping, and pre-insulated equipment.
- B. Cold Piping:
1. Application Requirements: Insulate the following cold plumbing piping systems:

- a. Potable cold water piping.
 - b. Condensate drains from HVAC units, refrigerated equipment, etc., including traps and lateral lines concealed above ceilings.
2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
- a. Fiberglass: 1 in. thickness.
 - b. Flexible Unicellular: 1 in. thickness.

3.3 INSTALLATION OF PIPING INSULATION

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- E. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.
- F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.
- G. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.
- H. Do NOT insulate over pipe hangers. If pipe hangers for piping to be insulated are not adequately sized for insulation to pass through the hanger, notify the General Contractor and Architect.

3.4 INSULATION EXPOSED TO WEATHER

- A. Protect outdoor insulation from weather by installation of weather-barrier metal jacketing. It may be factory-applied or field applied. Joints shall be overlapped a minimum of 2 inches. Securement shall be accomplished by using screws, rivets, or stainless steel bands. Any vapor-barrier jacket or coating under the metal jacketing shall not be disturbed or punctured by the use of screws or rivets on the outer jacket.

3.5 EXISTING INSULATION REPAIR

- A. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation of same thickness as existing insulation, install new jacket lapping and sealed over existing.

3.6 PROTECTION AND REPLACEMENT

- A. Replace damaged insulation that cannot be repaired satisfactorily, including units with vapor barrier damage and moisture-saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

**SECTION 221000
PLUMBING PIPING**

PART 1 - GENERAL

1.1 SUMMARY

- A. Extent of Plumbing Piping Work required by this section is indicated on Drawings and by requirements of this section.
- B. Types of Plumbing Piping systems specified in this section include the following:
 - 1. Domestic water system.
 - 2. Miscellaneous Drain Lines

1.2 REFERENCES

- A. ANSI/ASME B16.18 - Cast Copper Alloy Solder - Joint Pressure Fittings.
- B. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- C. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 NS 300.
- D. ANSI/ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
- E. ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- F. ANSI/ASME Sec. 9 - Welding and Brazing Qualifications.
- G. ANSI/ASTM B32 - Solder Metal.
- H. ANSI/ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- I. ANSI/AWS D1.1 - Structural Welding Code.
- J. AWS D10.12 - Recommended Practices and Procedures for Welding Plain Carbon Steel Pipe.
- K. AWS D10.9 - Qualifications and Procedures for Piping and Tubing Welding.
- L. AWS B3.0 - Welding Procedure and Performance Qualification.
- M. ANSI/AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
- N. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings 3 in. through 48 in., for Water and Other Liquids.
- O. ANSI/AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.
- P. ANSI/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

- Q. ASME - Boiler and Pressure Vessel Code.
- R. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- S. ASTM A74 - Cast Iron Soil Pipe and Fittings.
- T. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.
- U. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- V. ASTM B88 - Seamless Copper Water Tube.
- W. ASTM B306 - Copper Drainage Tube (DWV).
- X. ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.
- Y. ASTM C425 - Compression Joints for Vitrified Clay Pipe and Fittings.
- Z. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- AA. ASTM C 1540 - Heavy Duty Shielded Hubless Couplings
- BB. ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- CC. ASTM F477 - Electrometric Seals (Gaskets) for Joining Plastic Pipe.
- DD. ASTM F2657 - Standard Test Method for Outdoor Weathering Exposure of Crosslinked Polyethylene (PEX) Tubing
- EE. AWS A5.8 - Brazing Filler Metal.
- FF. AWWA C601 - Standard Methods for the Examination of Water and Waste Water.
- GG. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- HH. CISPI 310 - Couplings for Use with Hubless Cast Iron Soil Pipe and Fittings.
- II. NFPA 24 - Installation of private fire service mains and their Appurtenances, latest edition.

1.3 QUALITY ASSURANCE

- A. Plumbing Certification: Persons performing plumbing work shall have a current Texas State Plumbing License.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Conform to ASME Code and AWS 10.12.
- D. Welders Certification: In accordance with ANSI/ASME Sec. 9 or AWS D1.1, AWS D10.9, and AWS B3.0, as applicable.
- E. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute or receive prior approval of the engineer.

1.4 REGULATORY REQUIREMENTS

- A. Conform to the most recent editions of the applicable City codes and ordinances and NFPA 54.
- B. Piping materials specified herein are acceptable products to the Architect, but all are not necessarily acceptable to applicable local codes and ordinances. It is the responsibility of the Contractor to provide materials, from the options listed herein, that are acceptable to both the Architect and applicable local codes and ordinances.

1.5 SUBMITTALS

- A. Submit product data on pipe materials, fittings, valves and accessories in accordance with Division 01 and Section 220010.
- B. Submit shop drawings and piping layout in accordance with Division 01 and Section 220010.
- C. Submit certificates as listed below to Architect in accordance with Division 01 and Section 220010.
 - 1. Test Certificates of Approval for Piping Systems.
 - 2. Flushing Certificates of Approval for Piping Systems.
 - 3. Disinfection Certificates of Approval for Domestic Water Piping Systems.

1.6 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

PART 2 - PRODUCTS

2.1 WATER PIPING

- A. Water piping, above grade.
 - 1. Copper Tubing: For 4 in. diameter and less, ASTM B88, Type "L", hard drawn. Fittings: ANSI/ASME B16.18, cast brass, or ANSI/ASME B16.22, wrought copper. Joints: ANSI/ASTM B32, solder, Grade 95TA.

2.2 MISCELLANEOUS DRAIN PIPING

- A. Condensate Drain Piping:
 - 1. Copper pipe; ASTM B306, DWV fittings; ANSI/ASME B16.3, cast bronze, or AWSI/ASME B16.29, wrought copper. Joints: ANSI/ASTM B32, solder, Grade 50B.

2.3 FLANGES, UNIONS AND COUPLINGS

- A. Pipe Size 2 in. and under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.
- B. Pipe Size Over 2 in.: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; gaskets suitable for intended service – NO ASBESTOS GASKET MATERIAL ALLOWED.

- C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction and expansion; "C" shape composition sealing gasket; steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.
 - 1. Acceptable Manufacturers:
 - a. Victaulic
 - b. Apollo Shurjoint
- D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, and water impervious isolation barrier.

2.4 BALL VALVES

- A. Ball valves: For water, natural gas, and compressed air shut-off and throttling.
 - 1. Ball valves 2 in. and less: Rated 175 lb. minimum water, oil, air and gas pressure, brass or bronze construction, seat material as recommended by manufacturer for material conveying, lever handle, threaded or soldered connections. Throttling valves shall be provided with memory stops (for establishing any setpoint from 0-100% flow).
 - a. Acceptable Manufacturers and Models:
 - 1) Crane 9302, 9322
 - 2) Apollo 70 Series
 - 3) Jomar T-100-SS
 - 4) ITT Grinnell 3500, 3500SJ
 - 5) Milwaukee BA-200, BA-250
 - 6) Watts B-6000, B-6001
 - 7) Nibco T-580, & S-500
 - 8) KITZ 868

2.5 CHECK VALVES

- A. Swing check valves: For water, air, and pumped waste and drain.
 - 1. Check Valves 2 in. and less: MSS SP-80 rated 175 lb. minimum water and air pressure, brass or bronze construction, renewable seat, bronze disc, threaded or soldered connections.
 - a. Acceptable Manufacturers and Models:
 - 1) Nibco T-413
 - 2) Apollo 163T
 - 3) Crane 137

- 4) Jomar T/S-511
- 5) Stockham B-321
- 6) Milwaukee 508
- 7) KITZ 822

2.6 PLUMBING SUPPORTS AND ANCHORS

- A. Provide supports and anchors in accordance with Section 220529.

2.7 PLUMBING INSULATION

- A. Provide mechanical insulation in accordance with Section 220716.

PART 3 - EXECUTION

3.1 PIPING

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- E. Route piping in orderly manner and maintain gradient.
- F. Install piping to conserve building space and not interfere with use of space.
- G. Pipes passing through concrete or cinder walls and floor or other corrosive material shall be protected by a protective sheathing or wrapping or by sleeves, as required to meet the local code. Annular spaces between sleeves and pipes shall be filled or tightly caulked in an approved manner. Annular spaces between sleeves and pipes in fire-resistance-rated assemblies shall be filled or tightly caulked in accordance with the local code.
- H. Group piping whenever practical at common elevations.
- I. Exposed piping, valves, fittings, escutcheons, trim, etc., serving plumbing fixtures in finished areas, shall be polished chromium plated. Exposed piping, valves, fittings, escutcheons, trim, etc., serving plumbing equipment, kitchen equipment, or other equipment located in finished areas, shall be chrome plated, or when not available with chrome plating, they shall be painted with chromium paint.
- J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- K. Provide clearance for installation of insulation and access to valves and fittings.
- L. Provide access where valves and equipment are not accessible. Coordinate size and location of access doors with applicable Section.
- M. Slope water piping and arrange to drain at low points.

- N. Install piping parallel with or at right angles to walls unless otherwise shown on Drawings.
- O. Conceal piping above ceilings, in walls or chases etc., unless otherwise shown or noted on Drawings.
- P. Joints in soft copper piping below slab will not be allowed.
- Q. Soft copper shall not be routed through areas with exposed ceilings except in mechanical rooms.
- R. Bending of rigid piping is not permitted; only ells shall be utilized for a change in direction.
- S. Temporarily plug or cap open ends of pipe at the end of each workday.
- T. Establish invert elevations for drainage piping. Minimum slopes for drainage are 1/4 in. per foot for 3 in. diameter and less and 1/8 in. per ft. for 4 in. diameter pipe and greater.
- U. Install bell and spigot pipe with bell end upstream.
- V. Trap primer piping shall slope to floor drain at no less than 1/16 in. per ft. Horizontal trap primer piping shall run below floor. Piping in slab is not permitted.
- W. Install vented U-type drain trap on all draw-thru cooling coil drain pans.
- X. All sanitary waste stacks and storm drain down spouts 4 in. diameter and larger with vertical drops over 30 ft. 0 in. shall be provided with joint restraint on the horizontal branch or offset below the vertical drop. Threaded joints, grooved joints or a combination of pipe clamps and tie-rods as required in NFPA 24 shall accomplish joint restraint. Thrust blocks shall accomplish joint restraint below ground as required in NFPA 24. Vertical joint restraint shall be provided from the 90° ell at the bottom of the vertical drop through every joint up to the riser clamp at the floor penetration of the floor above. Horizontal joint restraint shall be provided from that same 90° ell through every joint on the horizontal branch.
- Y. Materials exposed within ducts or plenums (ceiling spaces used as supply or return air plenums) shall have a flame-spread index of not more than 25 and a smoke-developed rating of not more than 50 when tested in accordance with the test for Surface Burning Characteristics of Materials, U.B.C. Standard No. 42-1. Do not install any PVC piping in any Return Air Plenums.
- Z. Piping hangers shall be sized large enough to allow insulation to pass through. Hangers for piping 2-1/2 in. and greater shall be provided with pipe covering protection saddle, or high compressive strength insulation saddle. Hangers for piping 2 in. and less shall be provided with pipe covering shields. On cold or chilled water piping provide vapor barrier through hanger.
- AA. Domestic water service piping below building shall be provided with both tie-rod and thrust block restraint in accordance with NFPA 24. Tie-rod restraint shall be provided vertically from the below floor elbow at the base of the riser out to the first hub beyond 5 ft. 0 in. from building. (See NFPA 24-1995 figure A-8-6.2 (b)). Thrust block restraint shall be provided on the below floor elbow at the base of the riser. Area of bearing face of concrete thrust block shall be 32 sq. ft.
- BB. A pressure reducing valve station shall be furnished and installed on incoming domestic cold water lines with pressure exceeding 80 psi. Furnish valve station with separate strainer.

CC. Roof penetrations through metal roofs by the Plumbing or Mechanical Contractor will be required to have written approval by the Roofing Contractor.

3.2 PIPING CONNECTIONS

A. Threaded Connections

1. Threaded joints shall be in accordance with ANSI B1.20.1. Threaded joints shall be made up Teflon tape or lead free pipe joint compound applied to the male thread only. Should a joint be loosened after being made up, it shall not be made up a second time unless the threads are cleaned and new compound applied.
2. All steel piping which is assembled with screwed joints shall have exposed threads thoroughly primed with a coat of lead free rust resistant paint. Paint immediately after installation. This shall apply to both piping that is to be covered as well as uncovered.

B. Soldered Connections

1. Soldered joints shall be in accordance with ASTM B32. Flux shall be nonacid type. Remove composition discs from solder end valves during soldering. Pipe ends, fittings and valves shall be properly cleaned before soldering and wiped clean to remove flux and excess solder after soldering.

C. Solvent Cement Connections:

1. Solvent cement connections shall be joined with primer and PVC solvent cement complying with ASTM D2564. Solvent cement connections shall be in compliance with GSR Bulletin SCJ-1 Solvent Cementing Procedure.

D. Mechanical Grooved Connections:

1. Pipe shall be prepared and mechanical grooved connections shall be assembled in accordance with ANSI/AWWA C606 and the latest published instructions from the manufacturer.

3.3 FLANGES AND UNIONS

- A. Provide flanges and unions at all final connections to equipment, and traps. Arrange piping and piping connections so that equipment being served may be serviced or totally removed without disturbing piping beyond final connections and associated shut-off valves.
- B. All flanged connections shall be in accordance with ANSI B16.5 for steel flanges and ANSI B16.1 for cast iron flanges.
- C. Bolting shall be in accordance with ASTM A307 Grade B with bolts and nuts in accordance with ANSI B18.2.1 and ANSI B18.2.2.
- D. Tighten flange bolts in sequence 180° directly opposite each to equal tension.
- E. Flanges and unions shall be made of same material or compatible material as piping systems in which they are installed.

3.4 VALVES

- A. Install valves with stems upright or horizontal, not below horizontal.

- B. Horizontal swing check valves shall be installed in a true horizontal position. Vertical lift check valves shall be installed in a true vertical position.
- C. Install ball valves for shut-off and to isolate equipment, parts of systems, or vertical risers.
- D. Install ball valves for throttling, bypass or manual flow control services.
- E. Throttling or balancing valves shall be provided with memory stops.

3.5 TESTING

- A. General: Furnish pumps, gauges, equipment and personnel required, and test as necessary to demonstrate the integrity of the finished installation.
- B. Soil, Waste and Vent, and Storm Drainage: Unless otherwise directed, plug all openings and fill with water to a height equal to the lowest vent or roof drain. Allow to stand one hour or longer as required. Remake leaking joints and retest.
- C. Water Lines: Hydrostatically test and make tight at 150 psi. Retain for four hours. Repair all leaking joints and retest.
- D. Tests and test procedures shall be witnessed and approved by the Architect.
- E. After completion and approval of testing, submit "Test Certificates of Approval" for Sanitary Waste and Vent and Water piping systems stating that all test results are satisfactory. Certificates of approval must be signed by Contractor.

3.6 FLUSHING

- A. General: After piping systems have been tested and approved, systems shall be flushed. Furnish compressors, pumps, equipment, personnel, etc. required to flush piping systems.
- B. Water Lines: Flush piping with water until water flows clear for a minimum of 60 seconds per 100 linear ft. of piping being flushed at a velocity of 9 ft. per second.
- C. All strainers and filters shall be cleaned and replaced prior to start-up.
- D. Flushing and flushing procedures shall be witnessed and approved by the Architect.
- E. After completion and approval of flushing, submit "Flushing Certificates of Approval" for water piping systems stating that all flushing results are satisfactory. Certificates of approval must be signed by Contractor.

3.7 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50-to 80 mg/L residual.
- C. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 5 remote outlets.
- D. Maintain disinfectant in system for 24 hours.

- E. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- F. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- G. Take samples no sooner than 24 hours after flushing, from 5 remote outlets and from water entry, and analyze in accordance with AWWA C651.
- H. Disinfection and disinfection procedures shall be witnessed and approved by the Architect.
- I. After disinfection is completed, submit "Disinfection Certificate of Approval" for domestic water piping systems to the Architect stating that all test results are satisfactory. Certificate of Approval must be signed by Contractor. Certificate shall show the date, time and residual of each of the following tests:
 - 1. Initial disinfection residual (50 PPM minimum) - 5 samples.
 - 2. Final disinfection residual (25 PPM minimum) - 5 samples.
 - 3. After flushing residual (5 PPM maximum) - 5 samples.
 - 4. Analyze in accordance AWWA C651 - 5 samples.

3.8 CLOSING IN UNINSPECTED WORK

- A. Do not cover up or enclose work until it has been properly and completely inspected and approved. Should any of the work be covered up or enclosed prior to all required inspections and approvals, uncover the work as required. After it has been completely inspected and approved, make all repairs and replacements as necessary to the satisfaction of the Architect. Repairs and replacements shall be at no additional cost to the Owner.

END OF SECTION

**SECTION 221119
PIPING SPECIALTIES**

PART 1 - GENERAL

1.1 SUMMARY

- A. Extent of piping specialties work required by this section is indicated on Drawings and schedules and by requirements of this section.
- B. Types of piping specialties specified in this section include the following:
 - 1. Pipe Escutcheons.
 - 2. Dielectric Unions.
 - 3. Mechanical Penetration Seals.
 - 4. Fire Barrier Penetration Seals.
 - 5. Pipe Sleeves.
 - 6. Penetration Seals.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of piping specialties of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, including installation instructions, and dimensioned Drawings for each type of manufactured piping specialty. Include pressure drop curve or chart for each type and size of pipeline strainer. Submit schedule showing manufacturer's figure number, size, location, and features for each required piping specialty.

PART 2 - PRODUCTS

2.1 PIPING SPECIALTIES

- A. General: Provide factory-fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service, or if not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.

2.2 PIPE ESCUTCHEONS

- A. General: Provide pipe escutcheons as specified herein with inside diameter tightly fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

- B. Pipe Escutcheons for Moist Areas: Exterior use and interior use including mechanical rooms and any room with water or floor type drains. For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
- C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.
- D. Manufacturer: Subject to compliance with requirements, provide pipe escutcheons of one of the following or approved equal:
 - 1. Chicago Specialty Mfg. Co.
 - 2. Producers Specialty & Mfg. Corp.
 - 3. Sanitary-Dash Mfg. Co.

2.3 DIELECTRIC UNIONS

- A. General: Provide standard products recommended by manufacturer for use in service indicated, which effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and stop corrosion.
- B. Manufacturer: Subject to compliance with requirements, provide dielectric unions of one of the following or approved equal:
 - 1. B & K Industries, Inc.
 - 2. Capital Mfg. Co.; Div. of Harsco Corp.
 - 3. Eclipse, Inc.
 - 4. Epco Sales, Inc.
 - 5. Perfection Corp.
 - 6. Rockford-Eclipse Div.

2.4 PENETRATION SEALS

- A. Caulked Seals: Provide seals for penetrations through interior walls of one of the following:
 - 1. Mineral Wool or Oakum: Caulked watertight between sleeve and pipe.
- B. Mechanical Seals:
 - 1. General: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
 - 2. Manufacturer: Subject to compliance with requirements, provide mechanical sleeve seals of one of the following or approved equal.
 - a. Thunderline Corp.

C. Fire Barrier Seals:

1. Provide seals for any opening through smoke or fire-rated walls, and all above grade floors, used as passage for mechanical components such as piping or ductwork.
2. Cracks, Voids, or Holes Up to 4 in. Diameter: Use putty or caulking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, and capable of expanding 10 times when exposed to flame or heat, UL-listed.
3. Openings 4 in. or Greater: Use sealing system capable of passing 3-hour fire test in accordance with ASTM E-814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250 to 350°F UL-listed.
4. Manufacturer: Subject to compliance with requirements, provide fire barrier penetration seals of one of the following or approved equal.
 - a. Electro Products Div./3M.
 - b. Nelson; Unit of General Signal.

2.5 PIPE SLEEVES

A. Provide pipe sleeves of one of the following:

1. Sheet-Metal: Fabricate from galvanized sheet metal; round tube closed with snap lock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges: 3 in. and smaller, 20 gauge; 4 in. to 6 in. 16 gauge; over 6 in., 14 gauge.
2. Steel-Pipe: Fabricate from Schedule 10 (minimum) steel pipe; remove burrs.
3. Floor sleeves shall be provided with water stop around perimeter of sleeve.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration through floors, walls, partitions, and ceilings where penetration is exposed to view; and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surface.
- B. VANDAL PROOF Vent Caps: Install VANDAL PROOF vent caps on each vent pipe passing through roof, and elsewhere as indicated. Locate base of vent cap 6 in. above roof surface, or higher where require by Code.
- C. Dielectric Unions: Install at each piping joint between ferrous and non-ferrous piping. Comply with manufacturer's installation instructions.
- D. Mechanical Penetration Seals: Loosely assemble rubber links around pipe with bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form watertight seal.
- E. Fire Barrier Penetration Seals: Fill opening with sealing compound. Adhere to manufacturer's installation instructions.

F. Pipe Penetrations: Sleeve new construction or core drill existing construction pipe penetrations as specified below where piping passes through walls, floors, and roofs. Do not penetrate structural members, except as detailed on Drawings, or as reviewed by Architect. Install penetrations accurately centered on pipe runs. Size penetrations so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less than two pipe sizes larger than piping run. Where insulation includes vapor-barrier jacket, provide penetration with sufficient clearance for installation. When sleeves are required, install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except floor sleeves. Extend floor sleeves two inches above finished floor. Provide temporary support of sleeves during placement of concrete and other work around sleeves, and provide temporary closure to prevent concrete and other materials from entering sleeve. Pipe penetrations shall be as follows:

1. New floors on grade: Provide sleeved penetrations for all piping except piping two inches and less and waste, drain, and vent piping. Piping not requiring sleeves shall be provided with 30 lb. asphalt saturated roofing felt wrapped around pipe through the thickness of the floor with concrete floor placed up to roofing felt.
2. New floors above grade: Provide sleeved penetrations for all piping.
3. Existing Floors Above Grade: Provide core-drilled penetrations for all piping.
4. New and Existing Walls: Provide sleeved or core drilled penetrations for all piping.
5. Floor type drains, cleanouts, and water closet waste connections do not require sleeved or core drilled penetrations. Concrete shall be placed tight to connection.
6. Roof penetrations through metal roofs by the Plumbing or Mechanical Contractor will be required to have written approval by the Roofing Contractor.

G. Pipe Sleeves: Install in accordance with the following:

1. Install sheet metal on steel pipe sleeves in interior walls.
2. Install steel pipe sleeves in interior floors above grade.
3. Install galvanized steel pipe sleeves in floors on grade and in exterior walls above grade and below grade.

H. Penetration Seals:

1. Install mineral wool/oakum seals as follows:
 - a. In interior walls where piping passes from one space to another, where any one of the spaces the piping penetration is not concealed by a ceiling. Caulk penetration watertight.
2. Install mechanical seals in accordance with manufacturer's recommendations as follows:
 - a. In interior floors on grade.
 - b. In interior floors above grade, use three-hour fire rated type only.
 - c. In exterior walls above grade and below grade.

- d. In all roof penetrations except vent piping, flue piping, roof or overflow drain piping or any other piping as otherwise detailed on Drawing.
3. Install fire barrier seals in accordance with manufacturer's recommendations as follows:
- a. In all floors above grade, roofs and fire rated walls.

END OF SECTION

SECTION 230010
BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS AND SUPPLEMENTAL GENERAL PROVISIONS

- A. The "General Conditions" and "Supplementary Conditions" are by reference made a part of this section and shall apply to each and every heading as though included herein.
- B. In the event of conflict, the requirements of the "General Conditions" and "Supplementary Conditions" will take precedence over these "General Requirements".

1.2 GENERAL

- A. The Contractor shall provide all plans, labor, equipment, appliances and materials, and shall perform all operations in connection with the installation of the mechanical work in accordance with the Specifications, applicable drawings, and the conditions specified above.
- B. Contractor shall provide all equipment required and usually furnished in connection with such work and systems whether or not specifically mentioned or specifically indicated on the drawings.

1.3 INSPECTION OF THE SITE

- A. The Contractor shall visit the site, verifying all existing items indicated on drawings and/or specified, and familiarize himself with the existing work conditions, hazards, grades, actual formations, soil conditions, and local requirements. The submission of bids shall be deemed evidence of such visits.
- B. All proposals shall take these existing conditions into consideration, and the lack of specific information on the drawings shall not relieve the Contractor of any responsibility.
- C. In the event that equipment specified and/or reviewed is not compatible with the existing conditions, the trade furnishing the equipment shall be responsible for notifying the Contractor prior to ordering it.

1.4 PERMITS, UTILITY CONNECTIONS, AND INSPECTIONS

- A. Refer to other sections of the specifications for construction phasing and time increments.
- B. The Contractor shall obtain and pay for all required utility connections, utility extensions and/or relocations and shall pay all costs and inspection fees for all work included herein.

1.5 APPLICABLE CODES AND STANDARDS

- A. The installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards, which are made a part of the Specifications, except as may be hereinafter modified in these Specifications and associated drawings.
- B. Latest edition of the National Fire Protection Association Standards (NFPA):
 - 1. NFPA No. 70 National Electrical Code
 - 2. NFPA No. 90A Installation of Air Conditioning and Ventilating systems

3. NFPA No. 91 Exhaust systems of Air Conveying of Gases, etc.
 4. NFPA No. 96 Ventilation control and Fire Protection of Commercial Cooking Operations
 5. NFPA No. 101 Safety to Life from Fire in Buildings and Structures
 6. NFPA No. 255 Test of Surface Burning Characteristics of Building Materials
- C. United States of America Standards Institute (ASA) Standards:
1. A40.8 National Plumbing Code
 2. B31.1 & B31.1a Code for Pressure Piping
- D. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Codes.
- E. Air Conditioning and Refrigeration Institute Standards (ARI): All standards related to refrigeration and air conditioning equipment and piping furnished under these Specifications.
- F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) 1985: All applicable manuals and standards.
- G. Air Moving and Conditioning Association (AMCA): All applicable manuals and standards.
- H. American Society of Testing and Material (ASTM): All applicable manuals and standards.
- I. American Water Works Association (AWWA): All applicable manuals and standards.
- J. National Electrical Manufacturer's Association (NEMA): All applicable manuals and standards.
- K. City Fire Department as applicable to construction of this site.
- L. City and State Building Codes.
- M. State of (Texas) Occupational Safety Act: Applicable safety standards.
- N. Occupational Safety and Health Act (OSHA).
- O. State of (Texas) Energy Conservation Construction Code.
- P. All work shall be in accordance with all regulations and requirements of the State of Texas Architectural Barriers Act (TAS).
- Q. Texas Department of Health (TDH) Hospital Licensing Standards.
- R. Refer to Specifications sections hereinafter bound for additional codes and standards.
- S. All materials and workmanship shall comply with all applicable state and national codes, specifications, and industry standards. All material shall be listed by the Underwriter's Laboratories, Inc., as conforming to its standards and so labeled in every case where such a standard has been established for the particular type of material in question.
- T. All equipment provided and all installation methods shall meet all applicable requirements of the Fort Worth Energy Code.

- U. The Contract Documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by other specifications of the Contract Documents, providing no work or fabrication of materials has been accomplished in a manner of non-compliance. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations.

1.6 CONTRACT DOCUMENTS

- A. These specifications are accompanied by drawings of the building and details of the installations indicating the locations of equipment, piping, ductwork, outlets, switch controls, circuits, lines, etc. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.
- B. If the Contractor deems any departures from the drawings necessary, details of such departures and the reasons therefore shall be submitted to the Architect for review. No departures shall be made without prior written acceptance.
- C. There are intricacies of construction that are impractical to specify or indicate in detail; however, in such cases the current rules of good practice and applicable specifications shall govern.
- D. It is the Contractor's responsibility to properly use all information found on the Civil, Architectural, Structural, Mechanical, Plumbing, Fire Protection, and Electrical drawings where such information affects his work.
- E. All dimensional information related to new structures should be taken from the appropriate drawings. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the site.
- F. The interrelation of the specifications, the drawings, and the schedules is as follows: The specifications determine the nature and setting of the several materials, the drawings establish the quantities, dimensions and details, and the schedules give the performance characteristics.
- G. Should the drawings or specifications disagree within themselves, or with each other, the better quality of greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Architect in writing, shall be performed or furnished. Figures indicated on drawings govern scale measurements and large-scale details govern small-scale drawings.

1.7 SPACE AND EQUIPMENT ARRANGEMENT

- A. The size of fire protection, plumbing, mechanical, and electrical equipment indicated on the drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment he proposes to furnish will fit in the space. Shop drawings shall be prepared to indicate a suitable arrangement.
- B. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

- C. Maintain all code required clearances for equipment access.

1.8 FABRICATION DRAWINGS

- A. Contractor shall submit ductwork fabrication and hydronic piping shop drawings for review by the Architect. Fabrication drawings shall be fully coordinated with ALL other trades and with existing conditions.
- B. All required shop drawings, except as hereinafter specified, shall be prepared at a scale of not less than 1/4 in. equal to 1 ft. for floor plans and 1/4 in. equal to 1 ft. for mechanical rooms.

1.9 SUPERVISION

- A. Each contractor shall keep a competent superintendent or foreman on the job at all times necessary for the timely and proper completion of the work.
- B. It shall be the responsibility of each superintendent to study all drawings and familiarize himself with the work to be done by other trades. He shall coordinate this work with other trades, and before material is fabricated or installed, make sure that his work will not cause an interference that cannot be resolved without major changes to the drawings. If a conflict between trades arises that cannot be resolved at the jobsite, the matter shall be referred to the Architect for his ruling.

1.10 EXISTING FACILITIES

- A. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen, and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in-service maintenance of all plumbing, heating, air conditioning, and ventilating services for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, and remove all such temporary protection upon completion of the work. All barricades and safety devices shall be in compliance with OSHA.
- B. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.
- C. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.
- D. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, all Contractors shall remove and reinstall, in locations approved by the Architect, all devices required for the operation of the various systems installed in the existing construction. This is to include, but is not limited to, temperature control system devices, electrical switches, relays, fixtures, piping, conduit, etc.
- E. Outages of services, as required by the new installation, will be permitted only at a time approved by the Architect.

1.11 DEMOLITION AND RELOCATION

- A. The Contractor shall modify, remove and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition.
- B. All items that are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.
- C. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed and sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Architect. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas of facilities, which must remain in operation during the construction period, shall not be interrupted without prior specific approval of the Architect as hereinbefore specified.
- D. All equipment and materials indicated to be removed and not be re-used shall be disposed of by the Contractor.

1.12 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. The Contractor shall prepare, in triplicate for the Owner's Manual, complete sets of operating and maintenance instructions, system piping, valving, control and interlock diagrams, manuals, parts lists, etc., for each item of equipment. Include copies of all equipment warranties.
- B. In addition, the Contractor shall provide the services of a competent engineer or a technician acceptable to the Architect to instruct a representative of the Owner in the complete and detailed operation of all equipment and systems. These instructions shall be provided for a period of not less than 8 hours to fully accomplish the desired results. Upon completion of these instructions, a letter of release will be required, stating the dates of instruction and the personnel to whom instructions were given. The Contractor shall be responsible for proper maintenance until the instructions have been given to the Owner's maintenance personnel.

1.13 GUARANTEE

- A. All work and equipment shall be guaranteed for a period of one year from the date of substantial completion.
- B. Guarantee shall be for all labor and materials.
- C. Certain items for equipment shall have additional or extended warranties when so specified.

1.14 MATERIALS AND WORKMANSHIP

- A. All materials, unless otherwise specified, shall be of current U.S. manufacture, new, free from all defects, and of the best quality of their respective kinds. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall present a neat, workmanlike appearance. Materials, and/or equipment damaged in shipment, or otherwise damaged prior to installation, shall not be repaired at the job site, but shall be replaced with new materials and/or equipment.
- B. The responsibility for furnishing the proper equipment and/or material, and to see that it is installed as intended by the manufacturer rests entirely upon the Contractor, who shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

1.15 FLAME SPREAD PROPERTIES OF MATERIALS

- A. Materials and adhesives incorporated in this project shall conform to NFPA 255, latest edition. The classification shall not exceed No. 2, with the range of indices between 0 to 25 for these Classifications as listed in the Federal Specifications. Modifications shall be made to insulating materials, etc., as required to comply with the Federal Specification.

1.16 LARGE APPARATUS

- A. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

1.17 FLOOR AND CEILING PLATES

- A. Except as otherwise noted, provide chrome plated brass floor and ceiling plates around all pipes, conduits, ducts, etc., passing exposed through walls, floors, or ceilings, in any spaces, except under floor and attic spaces. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines that are insulated and positively secured to such pipe or insulation. Plates will not be required for piping where pipe sleeves extend 3/4 in. above finished floor. All equipment rooms are classified as finished areas. Round and rectangular ducts shall have plates made to fit accurately at all floor, wall and ceiling penetrations.

1.18 SLEEVES, INSERTS AND FASTENINGS

- A. Proper openings through floors, walls, roofs, etc., for the passage of piping, ductwork, etc., shall be provided. All penetrations must pass through sleeves except soil pipe installed under concrete slabs on fill. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Architect.
- B. Pipes passing through concrete or cinder walls and floor or other corrosive material shall be protected by a protective sheathing or wrapping or by sleeves, as required to meet the local code. Annular spaces between sleeves and pipes shall be filled or tightly caulked in an approved manner. Annular spaces between sleeves and pipes in fire-resistance-rated assemblies shall be filled or tightly caulked in accordance with the local code.

- C. The minimum clearance between horizontal penetrations including insulation where applicable, and sleeves shall be 1/4 in., except that the minimum clearance shall be 2 in. where piping contacts the ground. Sleeves through walls and partitions shall be installed flush with exposed surfaces. Sleeves through floors shall be extended 2 in. above finished floor.
- D. Above grade and dry location sleeves shall be constructed from 20 to 22 gauge galvanized steel. Sleeves passing through walls or floors on or below grade and/or moist areas such as mechanical rooms shall be constructed of galvanized steel Schedule 40 pipe and shall be designed with suitable flange in the center of the floor or wall to form a waterproof passage. After the pipes have been installed in the sleeves, void space around the pipe shall be sealed with "Link-Seal" modular wall and casing seals as manufactured by Thunderline Corporation.
- E. Suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction.
- F. Fastening of pipes, conduits, etc., in the building shall be as follows: To wood members - by wood screws; to masonry - by threaded metal inserts, metal expansion screws, or toggle bolts, whichever is appropriate for the particular type of masonry; to steel - machine screws or welding (when specifically permitted or directed), or bolts, and to concrete by suitable inserts anchored to reinforcing steel, and poured in place unless other means are acceptable for general use, and will only be permitted where specifically acceptable to the Architect.
- G. Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.
- H. Vermin Proofing: The open space around all ductwork, piping, etc., passing through the ground floor and/or exterior walls shall be sealed with a continuous bead of sealant.
- I. The space around piping, ductwork, etc., penetrating walls, ceilings and floors that define air plenums shall be sealed airtight in an acceptable manner. Ceiling plenums used for return air are considered air plenums.

1.19 ACCESS DOORS

- A. This Contractor shall provide wall or ceiling access doors for unrestricted access to all concealed shutoff or service valves, strainer, unions, pressure reducing valves, trap primers, water hammer arrestors, heat trace cable junction boxes, and other items of concealed mechanical equipment. All access door locations are not shown on the drawings. It is the Contractor's responsibility to provide access doors at all locations required.
- B. Access doors mounted in painted surfaces shall be equal to Milcor (Inland-Ryerson Construction Products Company) manufacture, Style K for plastered surfaces and Style M or DW for non-plastered surfaces. The Style K doors shall be set so that the finished surface of the door is even with the finished surfaces of the adjacent finishes. Access doors mounted on tile surfaces shall be stainless steel materials. Access doors shall be minimum of 18 in. x 18 in. in size.

1.20 CONSTRUCTION REQUIREMENTS

- A. The Civil, Architectural, Structural, Fire Protection, Mechanical, Plumbing, and Electrical plans and specifications including the General Provisions, Supplemental General Provisions, and other pertinent documents issued by the Architect, are a part of these specifications and the accompanying mechanical drawings, and shall be complied with in every respect. All the above is included in the Contract Documents, and shall be examined by all bidders. Failure to comply shall not relieve the Contractor of responsibility or be used as a basis for additional compensation due to omission of architectural, structural and electrical details from the mechanical drawings.
- B. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction may be required for work indicated or specified in this section or work specified in other sections, it shall be the responsibility of the Contractor to provide same as well as to provide material and equipment usually furnished with such systems or required to complete the installation, whether mentioned or not.
- C. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation supplied by the manufacturer of the equipment to be installed and thereby to provide an integrated satisfactory operating installation.
- D. The mechanical and associated drawings are necessarily diagrammatic in character and cannot show every connection in detail or every pipe or equipment in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate pipe hangers shall be set before concrete is poured, and proper openings through floor, walls, beams, etc., shall be provided as hereinafter specified or as otherwise indicated or required. All work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- E. When the mechanical drawings do not give exact details as to the elevation of pipe, ducts, etc., physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Piping and duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner, and the plans do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas. Piping specified to be insulated shall be supported in a manner that will allow the insulation to be installed without gaps. Insulated piping in concealed areas shall be offset with fittings as necessary to permit installation of insulation. Bending of pipes or installing pipes in a strain in order to insulate will not be permitted.
- F. All oiling devices and all parts of equipment requiring adjustment shall be easily accessible. Equipment shall be so located and installed as to permit convenient and safe maintenance and future replacement. Piping, ductwork, valve stems, etc., shall not block service space.

1.21 MECHANICAL SUBMITTALS

- A. Refer to the Conditions of the Contract (General and Supplementary) and Division 01 Section: "SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES" for submittal definitions, requirements, and procedures.
- B. Submittal of Shop Drawings, product data, and samples will be accepted only when submitted by The Contractor. Data submitted from Subcontractors and material suppliers directly to the Architect will not be processed.
- C. Submit Shop Drawings, product data, and samples on items indicated in the individual sections.
- D. Shop Drawings and submittal data shall not be used as requests or proposals for alternate equipment or materials. Refer to Item "Product Options and Substitutions" elsewhere in this section.
- E. THIRD PARTY CERTIFICATION: All Packaged equipment shall be independently Third Party labeled as a system for its intended use by a Nationally Recognized Testing Laboratory (NRTL) in accordance with OSHA Federal Regulations 29CFR1910.303 and .399, as well as NFPA Pamphlet #70, National Electric Code (NEC), Article 90-7.

1.22 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Refer to the Instructions to Bidders and the Division 01 Section "PRODUCTS AND SUBSTITUTION" for requirements in selecting products and requesting substitutions.
- B. Standards for Materials:
 - 1. These specifications indicate a standard for all materials incorporated into the work, with manufacturer's names and catalog numbers used to establish a grade and quality of materials and equipment. The manufacturer listed on the equipment schedules, or named first in the specifications, is the one on whose equipment the layout is based. Other named manufacturers must meet the indicated performance and space requirements.
 - 2. The "approved equal" clause used in these specifications is to permit the proposal of unnamed manufacturer's products for the work, and the Architect decision concerning equal products is final.
 - 3. Considerations as to determination of equal products include, but are not limited to, the following:

Materials	Physical size
Workmanship	Weight
Gauges of Materials	Appearance
Available Local Service Personnel	Performance
Previous successful installations	Capacity
Delivery Schedules	Required Equipment Clearances

- C. Requests for substitutions for equipment, materials and apparatus listed in Division 23 Sections must be submitted in writing a **MINIMUM OF 10 DAYS** prior to the scheduled bid date. Such requests must be accompanied by complete data to permit proper evaluation.

- D. BIDS SHALL NOT BE BASED ON UN-APPROVED MATERIALS, EQUIPMENT, OR APPARATUS. UNAPPROVED MATERIAL, EQUIPMENT OR APPARATUS WILL NOT BE ACCEPTED.
- E. Should electrical, water, drain, natural gas, structural support, or other similar requirements for alternate equipment, whether named in the specifications or approved as a substitution, be different from requirements for the products used in laying out the project, such changes shall be the responsibility of the Contractor, and shall not result in extra charges to the Owner, Architect, or Engineer.

1.23 RECORD DOCUMENTS

- A. Refer to the Division 01 Section: "CLOSEOUT PROCEDURES" for requirements. The following paragraphs supplement the requirements of Division 01.
- B. Mark Drawings to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned for column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.
- C. Mark Specifications to indicate approved substitutions; Change Orders; actual equipment and materials used.

1.24 PAINTING

- A. Field painting of mechanical equipment, duct systems, piping systems, etc., shall be accomplished under Division 09 of these specifications.
- B. Protection of Factory-applied Finishes:
 - 1. Factory-applied finishes on equipment and apparatus installed on the project shall be carefully protected.
 - 2. At the conclusion of the work, and prior to final acceptance of the project, equipment and apparatus shall be thoroughly cleaned of all construction dirt, oil and grease smears, temporary labels, debris, paint droppings, etc.
 - 3. Damaged factory finishes shall be restored to their original condition using procedures, materials and application techniques as set forth in Division 09 found elsewhere in these specifications.

1.25 CLEANING

- A. Refer to the Division 01 Section: "CLOSEOUT PROCEDURES" for general requirements for final cleaning.
- B. Refer to Division 23 Section: "TESTING, ADJUSTING, AND BALANCING" for requirements for cleaning filters, strainers, and mechanical systems prior to final acceptance.
- C. Name Plates:

1. All nameplates shall be protected from damage during the construction process.
 2. At the conclusion of the work, the nameplates shall be carefully cleaned and left in a fully legible condition.
- D. Removal of Rubbish: Each Contractor is responsible for the timely removal of rubbish and trash generated by his work, such as empty cartons, containers, materials crates, etc. Particular attention is called to residue that may present a potential tripping or injury hazard.

1.26 MOTORS AND DRIVES

A. Motors:

1. General: Motors shall be U/L-approved, with copper windings, and with a minimum Service Factor of 1.15. The nominal capacity shall exceed the brake horse-power requirements at duty schedules.
2. Motors 1/2 HP and smaller shall be 120-volt, single-phase with internal overload protection.
3. Motors 3/4 HP and larger shall be 208/230 or 460 -volt, 3-phase, unless scheduled or noted otherwise, and shall have thermal over-load cutouts in each phase as recommended by the motor manufacturer.
4. Motors shall be as manufactured by Century, General Electric, US Motors, Wagner, Westinghouse, or approved equal.

B. Drives:

1. Belts drives shall be rated for 150% of motor-rated horsepower.
2. Drive assemblies up to two (2) belts shall have adjustable motor sheaves with the mid-point of the adjustment range at the RPM required for the specified performance.
3. On drive assemblies with 3 or more belts, provide fixed motor sheaves for the specified RPM. Provide and install up to 2 pulley changes as necessary to achieve the required air quantities.
4. All multiple-belt drives shall be factory-marked-matched sets.

C. Specific requirements:

1. Provide high-efficiency motors for the following:
 - a. Air-Handling Units, as scheduled.
 - b. Ventilating Fans, as scheduled.
 - c. HVAC Pumps, as scheduled.
2. Efficiency ranges shall be as follows:

	Nominal HP	Minimum Efficiency	Premium Efficiency
	3	86.5	89.5

5	87.5	89.5
7.5	88.5	91.7
10	89.5	91.7
15	91.0	92.4
20	91.0	93.0
25	91.7	93.6
30	92.4	93.6
40	93.0	94.1
50, 60, 75	93.0, 93.6, 94.1	94.5, 95.0, 95.4
100	94.1	95.4

3. Motor efficiency certification shall be included with Product Submittal Data in accordance with Division 01 of these specifications.
4. Variable Speed (Frequency) AC Drives:
 - a. Where scheduled on the plans, provide and install variable speed (frequency) AC drives for motors.
 - b. Variable speed (frequency) AC drives shall be as described in Section 238965 - MOTOR CONTROLLERS - of these Specifications.
5. Motor Starters and Controllers:
 - a. Motor starters and controllers for fans, pumps, air-handling units, compressors, etc., which are not provided as an integral part of a factory-assembled package, shall be provided under Division 23 of the specifications. Refer to Section 238965 "MOTOR CONTROLLERS."

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

- A. The manufacturer's published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufacturer's materials or equipment, unless otherwise indicated. The Contractor shall promptly notify the Architect in writing of any conflict between the requirements of the Contract Documents and the manufacturer's directions and shall obtain the Architect instructions before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer's directions or such instructions from the Architect, he shall bear all costs arising in connection with the deficiencies.
- B. The Contractor shall not receive material or equipment at the jobsite until there is suitable space provided to properly protect equipment from rust, drip, humidity, and dust damage.
- C. Capacities shall be not less than those indicated but shall be such that no component or system becomes inoperative or is damaged because of start-up or other overload conditions.
- D. Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriter's Laboratories, Inc., or constructed and/or tested in accordance with the standards of the American Society of Mechanical Engineers or the Air Moving and Conditioning Association, the Contractor shall submit proof that the items furnished under these sections of the specifications conform to such requirements. The ASME stamp or the AMCA label will be acceptable as sufficient evidence that the items conform to the respective requirements.

- E. Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Observation.
- F. Standard factory finish will be acceptable on equipment specified by model number; otherwise surfaces of ferrous metal shall be given a rust-inhibiting coating. The treatment shall withstand 200 hours in salt-spray fog test, in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking, and no signs of rust creepage beyond 1/8 in. on either side of the scratch mark. Where rust-inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable, unless a specific coating is specified, except that coal tar or asphalt type coatings will not be acceptable, unless so stated for a specific item. Where steel is specified to be hot-dip galvanized, mill-galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-6215.
- G. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys and other rotating parts located so that any person can come in close proximity thereto, shall be fully enclosed or properly guarded.
- H. The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Architect of any discrepancy before performing any work. Adjustments to the work required, in order to facilitate a coordinated installation, shall be made at no additional cost to the Owner.

2.2 PROTECTION

- A. The Contractor shall at all times take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of the work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the incomplete building with tarpaulins or other protective covering. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.
- B. Take particular care not to damage the building structure in performing work. All finished floors, steel treads, and workmen or their tools and equipment shall cover finished surfaces to prevent any damage during the construction of the building.
- C. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final observation must be cleaned of rust and repainted as specified elsewhere in these specifications.

2.3 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS

- A. Each trade, subcontractor and/or contractor must work in harmony with the various other trades, subcontractors, and/or contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole. Each trade, subcontractor, and/or contractor must pursue his work promptly and carefully as not to delay the general progress of the job. This Contractor shall work in harmony with contractors working under other contracts on the premises.

2.4 PRECEDENCE OF MATERIALS

- A. These specifications and the accompanying drawings are intended to cover systems which will not interfere with the structural design of the building, which will fit into the available space, and which will insure complete and satisfactory systems. Each Contractor shall be responsible for the proper fitting of his material and apparatus into the building.
- B. Each Contractor shall so harmonize his work with that of the other trades so that it may be installed in the most direct and workmanlike manner without hindering or handicapping the other trades. Piping interferences shall be handled by giving precedence to pipelines that require a stated grade for proper operation. Where space requirements conflict, the following order of precedence shall, in general, be observed:
 - 1. Building lines
 - 2. Structural members
 - 3. Soil and drain piping
 - 4. Vent piping
 - 5. Condensate piping
 - 6. Refrigerant piping
 - 7. Supply ductwork
 - 8. Return ductwork
 - 9. Exhaust ductwork
 - 10. Chilled water and heating water piping
 - 11. Automatic Fire Protection Sprinkler Piping
 - 12. Domestic hot and cold water piping
 - 13. Electrical conduit

2.5 LOCATION OF OUTLETS IN ROOMS

- A. All fire protection, plumbing, acoustical tile, diffusers, grilles, registers, and other devices shall be referenced to coordinated, established data points and shall be located to present symmetrical arrangements with these points and to facilitate the proper arrangements of acoustical tile panels and other similar panels with respect to the mechanical and electrical outlets and devices. Those mechanical and electrical outlets shall be referenced to such features as wall and ceiling furrings, balanced border widths, masonry joints, etc. Outlets in acoustical tile shall occur symmetrically in tile joints or in the center of whole tiles. When locations of mechanical and electrical devices shown on the Architect reflected ceiling plans need to be modified, the final determination of the exact location of each outlet and the arrangement to be followed shall be acceptable to the Architect.
- B. The drawings show diagrammatically the location of the various outlets and apparatus. Exact locations of these outlets and apparatus shall be determined by reference to the general plans and to all detail drawings, equipment drawings, roughing-in drawings, etc., by measurements at the building, and in cooperation with the other trades. The Architect reserves the right to make any reasonable change in location of any outlet or apparatus before installation, without additional cost to the Owner.
- C. The Contractor, by submitting a bid on this work, sets forth that he has the necessary technical training and ability, and that he will install his work in a satisfactory and workmanlike manner which is up to the best standards of the trade, complete, and in good working order. If any of the requirements of the drawings and specifications are impossible of performance, or if the installation, when made in accordance with such requirements, will not perform satisfactorily, he shall report it to the Architect for correction promptly after discovery of the discrepancy.

2.6 CONNECTIONS FOR OTHERS

- A. This Contractor shall rough-in for and make all gas, water, steam, sewer, etc., connections to all fixtures, equipment, machinery, etc., provided by others in accordance with detailed roughing-in drawings provided by the equipment suppliers, along with actual measurements of the equipment connections, or as detailed.
- B. After the equipment is set in place, this Contractor shall make all final connections and shall provide all required pipe, fittings, valves, traps, etc.
- C. Provide all air gap fittings where required. In each water line serving an item of equipment or piece of machinery, provide a shut-off valve. On each drain not provided with a trap, provide a suitable trap.
- D. All pipefittings, valves, traps, etc., exposed in finished areas and connected to chrome-plated lines provided by others shall be chrome plated to match.
- E. Provide all sheet metal ductwork, transition pieces, etc., required for a complete installation of vent hoods, exhaust hoods, etc., provided by others.

PART 3 - INSTALLATION

3.1 INSTALLATION METHODS

- A. All pipes shall be concealed in pipe chases, walls, furred spaces, or above the ceiling, unless otherwise indicated.

- B. Piping may be run exposed in mechanical rooms, janitors' closets, or storage spaces, but only where necessary. All exposed piping shall be run in the neatest, most inconspicuous manner, and parallel or perpendicular to the building lines.
- C. All piping shall be adequately and properly supported from the building structure by means of hanger rods or clamps to walls as herein specified.
- D. Where limited space is available above the ceilings and below concrete beams or other deep projections, pipe and conduit shall be sleeved through the projection where it crosses, in a manner to provide maximum above-floor clearance. Sleeves shall be as specified or as required.
- E. All pipe, conduits, etc., shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All ducts, pipes and conduits run, exposed in machinery and equipment rooms, shall be installed parallel to the building plans, except as otherwise shown. Conduits in furred ceilings and in other concealed spaces may be run at angles to the construction but shall be neatly grouped and racked indicating good workmanship. All conduit and pipe openings shall be kept closed until the systems are closed with final connections.
- F. There shall be no pipe joints nearer than 12 in. to a wall, ceiling, or floor penetration, unless pipe joint is the welded type joint.
- G. The Contractor shall study all construction documents and carefully lay out all work in advance of fabrication and erection in order to meet the requirements of the extremely limited spaces. Where conflicts occur, the Contractor shall meet with all involved trades and the Architect and resolve the conflict, prior to erection of any work, in the area involved.

3.2 CUTTING AND PATCHING

- A. Cut and patch openings through walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction.
- B. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills at locations acceptable to the Architect. Impact-type equipment will not be used, except where specifically acceptable to the Architect. Openings in Precast concrete slabs for pipes, conduits, outlet boxes, etc., shall be core drilled or cast to exact size.
- C. All openings shall be restored to "as-new" condition under the appropriate Specification Section for the materials involved, and shall match remaining surrounding materials and/or finishes.
- D. Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Architect.
- E. All mechanical work in areas containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.
- F. No cutting, boring, or excavating, which will weaken the structure, shall be undertaken. **NO STRUCTURAL MEMBER MAY BE CUT WITHOUT THE WRITTEN APPROVAL OF THE ARCHITECT.**

3.3 ROOF PENETRATIONS AND FLASHING

- A. Pipe and duct sleeves and flashings compatible with the roofing installation shall be provided for roof penetrations. Manufacturer of roofing materials shall approve methods and materials. Pitch pans are not acceptable.
- B. Roof penetrations through metal roofs by the Plumbing or Mechanical Contractor will be required to have written approval by the Roofing Contractor.
- C. Piping penetration flashings shall be specially made for metal roofs and shall be EPDM or neoprene compression molded rubber with corrosion resistant metal base. Flashings shall be by Portals Plus, Inc., Buildex Dektite, or approved equal.

3.4 ROOF PIPING SUPPORTS

- A. Single run pipe 2-1/2 in. O.D. and less, shall have Type SS-8R as manufactured by Portable Pipe Hangers, Inc., or an approved equal, spaced at a maximum 8 ft. o.c. and installed on roof pads if required by Roofing Manufacturer. All conduits shall be held in place with clips on bars. Coordinate exact locations of supports with Roofing Contractor. Do not use wood blocking under supports.
- B. Multiple parallel runs, or piping and conduits larger than 2-1/2 in. O.D. shall have Type PS-1-2, PSE-2-2, or PP-10 with channel as manufactured by Portable Pipe Hangers, Inc., spaced at a maximum 8 in. o.c. and installed on roof pads if required by Roofing Manufacturer. All conduits shall be held in place with clips on bars. Coordinate exact locations of supports with Roofing Contractor. Do not use wood blocking under supports.
- C. Single run conduits 2-1/2 in. O.D. and less, shall have Type SS-8CL or SS-8C as manufactured by Portable Pipe Hangers, Inc., or an approved equal, spaced at a maximum 8 ft. o.c. and installed on roof pads if required by Roofing Manufacturer. All conduits shall be held in place with clips on bars. Coordinate exact locations of supports with Roofing Contractor. Do not use wood blocking under supports.
- D. Provide adjustable height threaded rod assembly supports as manufactured by MAPA Products model MS-1/MS-1-E or equal for supporting roof mounted condensate drain piping for pipe up to 2 in. Supports shall consist of a reinforced nylon support base, clamped pipe support bracket, and an adjustable threaded rod height assembly. A neoprene pad shall be adhered to the base. Install per manufacturer's instructions. Coordinate exact locations of supports with contractor.

3.5 FABRICATION OF PIPE

- A. All the various piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Lines shall also be graded for proper drainage.
- B. Piping shall follow as closely as possible the routes shown on plans, but shall take into consideration conditions to be met at the site.
- C. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after approval has been obtained.

- D. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping, in connections, and in equipment to which lines are connected.
- E. All piping shall be clean when it is installed. Before installation it shall be checked, upended, swabbed, if necessary, and all rust or dirt from storage shall be removed. Pipe shall not be permitted to lie on the ground during storage. Pipe ends shall be sealed during storage.

3.6 IDENTIFICATION AND LABELING

- A. The Contractor shall make it possible for the personnel operating and maintaining the equipment and systems in this project to readily identify the various pieces of equipment, valves, piping, etc., by marking them.
- B. All items of mechanical and electrical equipment shall be identified by the attachment of engraved nameplates constructed from laminated phenolic plastic, at least 1/16 in. thick, 3-ply, with black surfaces and white core. Engraving shall be condensed gothic, at least 1/2 in. high, appropriately spaced. Nomenclature on the label shall include the name of the item, its mark number, area, space, or equipment served, and other pertinent information. Equipment to be labeled shall include, but not be limited to, the following:
 - 1. Rooftop units
 - 2. Air Handling Units
 - 3. Furnaces
 - 4. Exhaust Fans
 - 5. Vent Fans
 - 6. Roof mounted fans
 - 7. Condensing Units
 - 8. Heat Pumps
 - 9. Circulating Pumps
 - 10. Air conditioning control panels and switches
 - 11. Motor controllers
 - 12. Miscellaneous similar and/or related items.
- C. The Contractor shall install identification tags to be affixed to those valves that have functions that are not obvious. For example, it would not be expected that valves at a pressure reducing station in a machine room would be tagged. The valve identification tags shall be brass discs, 2 in. in diameter. Each tag shall be attached to its valve with copper clad annealed iron wire or other approved material.

3.7 TESTS AND INSPECTIONS

- A. The Contractor shall, during the progress of the work and upon its completion, test his work and make all tests as required by the specifications, state, municipal and other authorities having jurisdiction of the work. Piping pressure tests shall be made before pipe is concealed or covered. Tests shall be made in the presence of authorities requiring tests. The Contractor shall pay all costs, inspection charges and fees required for the tests of his work.
- B. The Contractor shall provide all apparatus, temporary piping connection, etc., required for tests. The Contractor shall take all due precautions to prevent damage to the building or its contents incurred by such tests. The Contractor shall repair and make good at his own expense any damage caused by failures or leaks during the tests.
- C. Leaks, defects or deficiencies shall be repaired and/or replaced, and tests shall be repeated until the test requirements are complied with fully.
- D. All equipment shall be placed in operation and tested for proper automatic control before the final balancing of the system is started.
- E. All tests shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel, description, and extent of system tested, test condition, test results, specified results, and any other pertinent data. Data shall be delivered to the Architect.

3.8 COOPERATION AND CLEANUP

- A. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the job site in a clean and safe condition. At the end of each day's work, each trade shall properly store all of his tools, equipment and materials and shall clean his debris from the job. Upon the completion of the job, each trade shall immediately remove all of his tools, equipment, any surplus materials and all debris caused by his portion of the work.

3.9 CLEANING AND PAINTING

- A. All equipment, piping, ductwork, grills, insulation, etc., in finished areas furnished and installed by the Contractor shall be painted. Finished areas include mechanical rooms, boiler rooms, and outside the building as well as occupied areas inside the building. Final painting is to be done by the General Contractor. This Contractor shall thoroughly clean all part of materials and equipment of cement, plaster, and other materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Exposed metal work shall be carefully brushed down with steel brushes to remove rust and other spots and left smooth and clean.
- B. This Contractor shall thoroughly clean the finish on all parts of the materials and equipment with factory applied finishes. Exposed parts in equipment rooms, above crawl space slabs, and all other spaces except sealed chases and attics shall be thoroughly cleaned of cement, plaster and other materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. If the finish has been damaged, the Contractor shall re-paint to the satisfaction of the Architect.
- C. All canvas finishes shall be painted with one sizing coat if not already sized, containing a mildew resistant additive and Arabol adhesive prior to any other specified finish paint.

- D. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible during painting operation.

3.10 ELECTRICAL PROVISIONS OF MECHANICAL WORK

- A. The extent of electrical provisions to be provided as mechanical work is indicated in other mechanical sections of the specifications, on the drawings and as further specified in this section.
- B. Starters, Controllers: In general, mechanical work includes furnishing combination starters. Controllers are specifically included as electrical work when mounted in motor control centers. Electrical work includes installation, mounting and wiring of starters and controllers that are furnished as mechanical work. Free standing, large motor controllers shall be set in place, on pads, as mechanical work.
- C. Electrical heating equipment shall be furnished complete with internal or integral fusing and subdivision of loads to comply with the NEC.
- D. Wherever possible, match the elements of the electrical provisions of mechanical work with similar elements of the electrical work specified in electrical sections of the specifications.
- E. Standards:
 - 1. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards to definitions of terminology herein.
 - 2. Comply with National Electrical Code (NFPA No. 70) for installation requirements.
 - 3. Comply with National Electrical Contractors Association (NECA) "Standard of Installation".

3.11 TEMPORARY FACILITIES

- A. Unless noted otherwise in the Supplementary General Conditions; provide temporary facilities.

3.12 EQUIPMENT INSTALLATION REQUIREMENTS

- A. All mechanical equipment shall be furnished and installed complete and ready for use.
- B. Others shall furnish certain kitchen, lab, or Owner process equipment. Contractor shall be responsible for furnishing and installing all items as required to make kitchen equipment complete operating systems. The Contractor shall furnish and install all auxiliary piping, valves, controls, control wiring, conduit, alarms, etc., required. All necessary devices, control wiring, conduit, etc., will not necessarily be shown on the drawings.

3.13 OWNER FURNISHED EQUIPMENT

- A. The Contractor's responsibility shall include receiving and installing all Owner-furnished equipment.

END OF SECTION

**SECTION 230512
MECHANICAL AND ELECTRICAL COORDINATION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
- B. Refer to Section 210010 - BASIC FIRE PROTECTION REQUIREMENTS.
- C. Refer to Section 220010 - BASIC PLUMBING REQUIREMENTS.
- D. Refer to Section 230010 - BASIC MECHANICAL REQUIREMENTS.

1.2 SUMMARY

- A. This Section describes the coordination between the Fire Protection, Plumbing, Mechanical and Electrical portions of the work.
- B. This Section is included under the Division 21 portion of the Specifications as Section 210512, under the Division 22 portion of the Specifications as Section 220512, under the Division 23 portion of the Specifications as Section 230512, and under the Division 26 portion of the Specifications as Section 260512.

1.3 WORK INCLUDED

- A. Responsibility: Unless otherwise indicated, motors and controls shall be furnished, set in place and wired in accordance with the following schedule. **This schedule may include equipment and systems that are not required for this project. Only the equipment and systems that are required on the drawings and/or specified elsewhere will be required by this section:**

1.	Equipment Motors	21/22/2 3	21/22/2 3	26
2.	Magnetic Motor Starters			
	a. Automatically controlled, with or without HOA switches	21/22/2 3	26	Notes 1,3,5
	b. Automatically controlled, with or without HOA switches and furnished as part of	21/22/2 3	22/23	Notes 1,3,5

	factory wired equipment			
	c. Manually controlled	21/22/23	26	Notes 1,3,5
	d. Manually controlled and furnished as part of factory wired equipment	21/22/23	26	Notes 1,3,5
	e. Furnished in Motor Control Centers	26	26	Notes 1,3,5
3.	Variable Speed (Frequency) AC Drives	22/23	26	Notes 1,4,5
4.	Line voltage thermostats, time clocks, etc., not connected to control panel systems	23	26	23
5.	Electric thermostats, time clocks, remote bulb thermostats, motorized valves, float controls, etc. which are an integral part or directly attached to ducts, pipes, etc.	22/23	22/23	22/23
6.	Temperature control panels and time switches	23	23	23

	mounted on temperature control panels			
7.	Motorized valves, motorized dampers, solenoid valves, EP and PE switches, etc.	23	23	Note 1
8.	Alarm bells furnished with equipment installed by Division 22 or 23	22/23	22/23	22/23
9.	Wiring to obtain power for control circuits, including circuit breaker	21/22/2 3	21/22/2 3	21/22/2 3
10.	Low voltage controls	21/22/2 3	21/22/2 3	21/22/2 3
11.	Fire protection system (sprinkler) controls	21	21	Note 8
12.	Fire and smoke detectors installed on mechanical units and in ductwork	28	23	Note 8
13.	All relays required for fan shutdown, motorized dampers, smoke	23	23	Note 1

	control devices, and other items integral with HVAC equipment to provide operation and control of HVAC equipment			
14	Smoke dampers, and combination fire/smoke dampers	23	23	Note 7
15	Boiler and water heater controls, boiler burner controls panels	22/23	22/23	22/23
16	Pushbutton stations, pilot lights	22/23	22/23	22/23
17	Heat Tape	21/22/2 3	21/22/2 3	26
18	Disconnect switches, manual operating switches furnished as a part of the equipment	21/22/2 3	21/22/2 3	Notes 1,5
19	Disconnect switches, manual operating switches furnished separate from equipment	26	26	26
20	Multispeed switches	23	23	26
21	Thermal overloads	21/22/2 3	21/22/2 3	21/22/2 3

22	Control relays, transformers	21/22/23	21/22/23	21/22/23				
23	Refrigeration cycle, cooling tower and controls	23	23	23				
24	Tamper switches for fire protection (sprinkler) system	21	21	28				
25	Flow and/or pressure switches for fire protection (sprinkler) system	21	21	28				
26	Fire and jockey pump controllers and automatic transfer switch	21	21	Note 6				
27	Alarm bells or horns for fire protection (sprinkler) system	21	21	28				
28	Generator (underground) fuel tank	22	22	--				
29	Generator fuel level indicator	22	22	26				
30	Generator fuel piping from tank to generator	22	22	--				
31	Underground fuel tank leak detection and	22	22	22	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION

	monitoring system								
NOTES:	(1)	Power wiring as defined in Section 262913 of the specifications shall be provided under Division 26; control wiring as defined in Section 262913 of the specifications shall be provided under Division 21/22/23.							
	(2)	Wiring from alarm contacts to alarm systems provided by Division 26, wiring from auxiliary contacts to air handling system controls provided by Division 23. Division 26 shall provide power to smoke detector. Smoke detectors required for all air handling systems 2000 CFM or greater. Refer to other Division 23 specifications, Division 26 and Drawings for more specific requirements.							
	(3)	For requirements for Magnetic Motor Starters, refer to Section 238965 - MOTOR CONTROLLERS.							
	(4)	For requirements for Variable Speed (Frequency) AC drives, refer to Section 238965 - MOTOR CONTROLLERS.							
	(5)	Disconnect switches, operating switches, starters and other similar items that are factory-mounted, as a part of complete assembly, shall comply with applicable provisions of the National Electric Code. All such disconnect switches shall be fused.							
	(6)	Power wiring from energy source to controllers and automatic transfer switch shall be provided under Division 26. Interconnection power and control wiring from controllers and automatic transfer switch to pumps shall be provided under Division 21, 22 or 23 and conforming to Division 26 specifications. Control wiring from automatic transfer switch to generator starter shall be provided under Division 26.							
	(7)	Division 26 will provide power to all smoke and combination fire/smoke dampers, and Division 28 will provide control for all such dampers using area smoke detectors.							
	(8)	Wiring for sprinkler system controls to be provided by Division 21. Wiring from devices to Fire Alarm System to be provided by Division 28.							

B. CONNECTIONS: Make all connections to controls that are directly attached to ducts, piping and mechanical equipment with flexible connections.

C. PRECEDENCE

1. In general, piping systems that require a stated grade for proper operation shall have precedence over other systems.
2. Precedence for pipe, conduit and duct systems shall be as follows.
 - a. Building lines
 - b. Structural members
 - c. Soil and drain piping
 - d. Vent piping

- e. Condensate piping
 - f. Refrigerant piping
 - g. Supply ductwork
 - h. Return ductwork
 - i. Exhaust ductwork
 - j. Chilled water and heating water piping
 - k. Automatic Fire Protection Sprinkler Piping
 - l. Domestic hot and cold water piping
 - m. Electrical conduit
3. Lighting Fixtures shall have precedence over air grilles and diffusers.

D. FINAL INSPECTION AND REPORT

1. At the completion of the work, there shall be a meeting of the Fire Protection, Plumbing, Mechanical, Electrical Fire Alarm and Temperature Control Contractors, representatives of mechanical and electrical equipment manufactures whose equipment was actually installed on the project, and similarly-involved individuals, who shall thoroughly inspect all systems, and who shall mutually agree that all equipment has been properly wired and installed, and that all temperature and safety controls are properly functioning. A written report of this meeting, listing those in attendance, and the companies that they represent, shall be filed with the Owner and Architect or Engineer.

END OF SECTION

**SECTION 230529
MECHANICAL SUPPORTS AND ANCHORS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Extent of supports and anchors required by this section is indicated on Drawings and/or specified in other Division 23 sections.
- B. Types of supports and anchors specified in this section include the following:
 - 1. Pipe and equipment hangers, supports, and anchors.
 - 2. Equipment bases.
- C. Supports and anchors furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 23 sections.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. Code Compliance: Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.
 - 2. Fire Protection Compliance: Install in accordance with NFPA 13-latest edition. Provide products that are UL-listed and FM approved.
 - 3. MSS Standard Compliance:
 - a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.
 - b. Select and apply pipe hangers and supports, complying with MSS SP-69.
 - c. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
 - d. Terminology used in this section is defined in MSS SP-90.
- C. Manufacturers of Hangers and Supports:
 - 1. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:
 - a. B-Line Systems Inc. (Cooper)
 - b. ANVIL International

1.3 SUBMITTALS

- A. Submit product data as required under provisions of Division 01 and Section 230010.

- B. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor.

PART 2 - PRODUCTS

2.1 HORIZONTAL-PIPING HANGERS AND SUPPORTS

- A. General: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.
- B. Adjustable Steel Clevis Hangers: MSS Type 1.
- C. Yoke Type Pipe Clamps: MSS Type 2.
- D. Steel Double Bolt Pipe Clamps: MSS Type 3.
- E. Steel Pipe Clamps: MSS Type 4.
- F. Pipe Hangers: MSS Type 5.
- G. Adjustable Swivel Pipe Rings: MSS Type 6.
- H. Adjustable Steel Band Hangers: MSS Type 7.
- I. Adjustable Band Hangers: MSS Type 9.
- J. Adjustable Swivel Rings, Band Type: MSS Type 10.
- K. Split Pipe Rings: MSS Type 11.
- L. Extension Split Pipe Clamps: MSS Type 12.
- M. U-Bolts: MSS Type 24.
- N. Clips: MSS Type 26.
- O. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:
 - 1. Plate: Unguided type.
 - 2. Plate: Guided type.
 - 3. Plate: Hold-down clamp type.
- P. Pipe Saddle Supports: MSS Type 36, including steel pipe base-support and cast-iron floor flange.
- Q. Pipe Stanchion Saddles: MSS Type 37, including steel pipe base support and cast-iron floor flange.

- R. Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast-iron floor flange.
- S. Single Pipe Rolls: MSS Type 41.
- T. Adjustable Roller Hangers: MSS Type 43.
- U. Pipe Roll Stands: MSS Type 44.
- V. Pipe Rolls and Plates: MSS Type 45.
- W. Adjustable Pipe Roll Stands: MSS Type 46.

2.2 VERTICAL-PIPING CLAMPS

- A. General: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.
- B. Two-Bolt Riser Clamps: MSS Type 8.
- C. Four-Bolt Riser Clamps: MSS Type 42.

2.3 HANGER-ROD ATTACHMENTS

- A. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.
- B. Steel Turnbuckles: MSS Type 13.
- C. Steel Clevises: MSS Type 14.
- D. Swivel Turnbuckles: MSS Type 15.
- E. Malleable Iron Sockets: MSS Type 16.
- F. Steel Weldless Eye Nuts: MSS Type 17.

2.4 BUILDING ATTACHMENTS

- A. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.
- B. Top Beam C-Clamps: MSS Type 19.
- C. Side Beam or Channel Clamps: MSS Type 20.

- D. Center Beam Clamps: MSS Type 21.
- E. Welded Beam Attachments: MSS Type 22.
- F. C-Clamps: MSS Type 23.
- G. Top Beam Clamps: MSS Type 25.
- H. Side Beam Clamps: MSS Type 27.
- I. Steel Beam Clamps W/Eye Nut: MSS Type 28.
- J. Linked Steel Clamps W/Eye Nut: MSS Type 29.
- K. Malleable Beam Clamps: MSS Type 30.
- L. Steel Brackets: One of the following for indicated loading:
 - 1. Light Duty: MSS Type 31, suspending 750 lbs. max.
 - 2. Medium Duty: MSS Type 32, suspending 1500 lbs. max.
 - 3. Heavy Duty: MSS Type 33, suspending 3000 lbs. max.
- M. Side Beam Brackets: MSS Type 34.
- N. Plate Lugs: MSS Type 57.
- O. Horizontal Travelers: MSS Type 58.

2.5 CONCRETE INSERTS

- A. Cast-In-Place Spot Type: Malleable iron, or steel with recommended insert nut. Size inserts nut to suit threaded hanger rod. MSS SP-69, Type 18.
- B. Drill-In Spot Type: Steel, attached wedge, lock washer and nut. Size inserts to suit threaded hanger rod.
 - 1. Acceptable Manufacturers and Models:
 - a. Hilti "Kwik Bolt"
 - b. Ramset "Wedge Anchor"
 - c. Rawl "Stud"
- C. Continuous Channel Type: Steel, anchoring lugs, with channel nuts, rated for 2000 lbs. per foot minimum load. Size channel nut to suit threaded hanger rod.
 - 1. Acceptable Manufacturers and Models:
 - a. B-Line B22
 - b. Elcen 1150
 - c. Unistrut P3200

2.6 SADDLES AND SHIELDS

- A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.
- B. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.
- C. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.
- D. Thermal Hanger Shields: Constructed of 360° insert of high density, 125-psi compressive strength, and water-proofed calcium silicate, encased in 360° sheet metal shield. Provide assembly of same thickness as adjoining insulation.
 - 1. Manufacturer: Subject to compliance with requirements, provide thermal hanger shields of one of the following:
 - a. Elcen Metal Products Co.
 - b. Pipe Shields, Inc.

2.7 SPRING HANGERS AND SUPPORTS

- A. General: Except as otherwise indicated, provide factory-fabricated spring hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select spring hangers and supports to suit pipe size and loading.
- B. Restraint Control Devices: MSS Type 47.
- C. Spring Cushion Hangers: MSS Type 48.
- D. Spring Cushion Roll Hangers: MSS Type 49.
- E. Spring Sway Braces: MSS Type 50.
- F. Variable Spring Hangers: MSS Type 51; preset to indicated load and limit variability factor to 25%.
- G. Variable Spring Base Supports: MSS Type 52; preset to indicated load and limit variability factor to 25%; include load flange.
- H. Variable Spring Trapeze Hangers: MSS Type 53; preset to indicated load and limit variability factor to 25%.
- I. Constant Supports: Provide one of the following types, selected to suit piping system. Include auxiliary stops for erection and hydrostatic test, and field load-adjustment capability.
 - 1. Horizontal Type: MSS Type 54.
 - 2. Vertical Type: MSS Type 55.

3. Trapeze Type: MSS Type 56.

2.8 MISCELLANEOUS MATERIALS

- A. Metal Framing: Provide products complying with NEMA STD ML 1.
- B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.
- C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.
- D. Auxiliary Steel: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.
- E. Pipe Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

2.9 ROOF EQUIPMENT SUPPORTS

- A. General: Construct roof equipment supports using minimum 18 ga. galvanized steel with fully mitered and welded corners, 3 in. cant, internal bulkhead reinforcing, integral base plates, pressure treated wood nailer, and 18 ga. galvanized steel counter flashing.
- B. Configuration: Construct of sizes as indicated, compensate for slope in roof so top of support is dead level.
- C. Manufacturer: Subject to compliance with requirements, provide roof equipment supports of one of the following:
 - 1. Pate Co.
 - 2. Thycurb Div.; Thybar Corp.

2.10 ROOF PIPING SUPPORTS

- A. Single run pipe and conduits 2-1/2 in. O.D. and less, shall have Type SS-8R (piping) as manufactured by Portable Pipe Hangers, Inc., or an approved equal, spaced at a maximum 8 ft. o.c. and installed on roof pads if required by Roofing Manufacturer. All conduits shall be held in place with clips on bars. Coordinate exact locations of supports with Roofing Contractor. Do not use wood blocking under supports.
- B. Multiple parallel runs, or piping and conduits larger than 2-1/2 in. O.D. shall have Type PS, PSE, PP-10 with roller, or PP-10 with bar as manufactured by Portable Pipe Hangers, Inc., spaced at a maximum 8 ft. o.c. and installed on roof pads if required by Roofing Manufacturer. All conduits shall be held in place with clips on bars. Coordinate exact locations of supports with Roofing Contractor. Do not use wood blocking under supports.

- C. Provide adjustable height threaded rod assembly supports as manufactured by MAPA Products Model MS-1/MS-1-E or equal for supporting roof mounted condensate drain piping for pipe up to 2 in. Supports shall consist of a reinforced nylon support base, clamped pipe support bracket, and an adjustable threaded rod height assembly. A neoprene pad shall be adhered to the base. Install per manufacturer's instructions. Coordinate exact locations of supports with contractor.
- D. All refrigerant piping on the roof shall be supported with Pipe Pier model PP050 piping supports or approved equal. Spacing of pipe supports shall not exceed 8 ft. for pipes up to 1-1/4 in. and 10 ft. on all other piping. Coordinate exact locations of supports with Roofing Contractor. Install piping supports per manufacturer's instructions. Pipe supports shall be constructed of 10 in.-L x 4 in.-W x 4 in.-H closed cell, medium density black polyethylene foam with a 14 ga. channel strut adhesively bonded to the polyethylene foam. Roofing Contractor shall provide roofing material pads under all supports.

2.11 ROOF PENETRATION SYSTEMS

- A. General: Construct roof penetration systems utilizing the "Alumi-Flash" system by Portals Plus, Inc., or equal by Thy-Curb.
- B. Each roof penetration shall include a spun aluminum base ("High" size if required due to the existing roof construction and any insulation thickness) and an EPDM rubber cap. Each rubber cap shall have a pre-molded pipe opening and shall be selected based on the actual pipe or conduit size required at each location. Secure each rubber cap to each pipe or conduit with the manufacturer's recommended stainless steel gear clamp.
- C. Manufacturer: Subject to compliance with requirements, provide roof penetration systems of one of the following:
 - 1. Portals Plus, Inc. Ron Widby 800-774-5240
 - 2. Thycurb Div.; Thybar Corp. Jr. Gracia 972-416-6220

2.12 ON GRADE PIPING SUPPORTS

- A. All refrigerant piping on the ground shall be supported with Dura-Blok supports by Cooper B-Line, DB series or approved equal. Install piping supports per manufacturer's instructions. Pipe supports shall be constructed of 9.5 in. L x 6 in. W x 4 in. H recycled rubber, UV resistant, with a 14 gauge channel strut secured to rubber base. All piping shall be clamped and secured to the channel strut. Spacing of pipe supports shall not exceed 6 ft.

2.13 CONCRETE HOUSEKEEPING BASES

- A. Concrete housekeeping bases shall be in accordance with Division 3 and constructed of 4,000 psi concrete and reinforced with welded wire fabric in accordance with ASTM A 185 or deformed reinforcing bar in accordance with ASTM A 615, Grade 60.
- B. Reinforcement shall be provided for base thickness as follows unless otherwise noted.

	Thickness of Base	Size and Type of Reinforcement	Spacing and Location of Reinforcement
	4 in.	W 2.9 x 2.9 welded	6 in. x 6 in. at centerline of pad

	6 in.	No. 3 bars	18 in. on center each way (3 in. from top of pad)
	8 in.	No. 4 bars	18 in. on center each way (3 in. from top of pad)
	12 in.	2 sets of No. 4 bars	Two mats 18 in. on center each way (3 in. from top of pad and 3 in. from bottom of pad)

2.14 SLEEVES, INSETS AND FASTENINGS

- A. Pipes passing through concrete or cinder walls and floor or other corrosive material shall be protected by a protective sheathing or wrapping or by sleeves, as required to meet the local code. Annular spaces between sleeves and pipes shall be filled or tightly caulked in an approved manner. Annular spaces between sleeves and pipes in fire-resistance-rated assemblies shall be filled or tightly caulked in accordance with the local code.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.
- B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.3 INSTALLATION OF BUILDING ATTACHMENTS

- A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at all changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

- A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Install additional at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at all changes in direction of piping. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
- B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
- C. Support fire-water piping independently of other piping.
- D. Prevent electrolysis in support of copper tubing by use of hangers and supports that are copper plated, or by other recognized industry methods.
- E. Support and laterally brace vertical pipe runs at every floor level and at intervals not to exceed 20 ft. 0 in. Support vertical pipe with riser clamps installed below hubs, couplings or lugs welded to the pipe.
- F. Provisions for Movement:
 - 1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
 - 2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
 - 3. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.
- G. Insulated Piping: Comply with the following installation requirements.
 - 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps; do not exceed pipe stresses allowed by ANSI B31.
 - 2. Piping hangers shall be sized large enough to allow insulation to pass through. Hangers for piping 2-1/2 in. and greater shall be provided with pipe covering protection saddle, or high compressive strength insulation saddle. Hangers for piping 2 in. and less shall be provided with pipe covering shields. On cold or chilled water piping provide vapor barrier through hanger.
 - 3. Do NOT utilize "pipe size" hangers or clamps with insulation placed over the pipe and hanger or clamp.

3.5 INSTALLATION OF ANCHORS

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.
- C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.
- D. Anchor spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.6 CONCRETE HOUSEKEEPING BASES

- A. Concrete housekeeping bases will be provided as work of Division 03. Furnish to Contractor, scaled layouts of all required bases, with dimensions of bases, and location to column centerlines. Furnish templates, anchor bolts, and accessories, necessary for base construction.
- B. Provide concrete housekeeping bases for all floor-mounted equipment furnished as part of the work of Division 23 in accordance with Division 03. Size bases to extend minimum of 4 in. beyond equipment base in any direction; and 4 in. above finished floor elevation, unless otherwise noted on Drawing. Construct of reinforced concrete, roughen floor slab beneath base for bond, and provide steel rod anchors between floor and base. Locate anchor bolts using equipment manufacturer's templates. Chamfer top and edge corners.

3.7 EQUIPMENT SUPPORTS

- A. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands.
- B. Furnish roof equipment supports to Contractor for installation as part of work of Division 07; not work of this section.

3.8 ADJUSTING AND CLEANING

- A. Hanger Adjustments: Adjust hangers so as to distribute loads equally on attachments.
- B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.
- C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 230553
MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Extent of mechanical identification work required by this section is indicated on Drawings and/or specified in other Division 23 sections.
- B. Types of identification devices specified in this section include the following:
 - 1. Plastic Pipe Markers.
 - 2. Plastic Duct Markers.
 - 3. Valve Tags.
 - 4. Valve Schedule Frames.
 - 5. Engraved Plastic-Laminate Signs.
- C. Mechanical identification furnished as part of factory-fabricated equipment, is specified as part of equipment assembly in other Division 23 sections.
- D. Refer to other Division 23 sections for identification requirements at central-station mechanical control center; not work of this section.
- E. Refer to Division 26 sections for identification requirements of electrical work; not work of this section.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.
- B. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2 in. x 11 in. bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 01.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide mechanical identification materials of one of the following:
 - 1. Allen Systems, Inc.
 - 2. Brady (WHO) Co.; Signmark Div.
 - 3. Industrial Safety Supply Co., Inc.
 - 4. Seton Name Plate Corp.

2.2 MECHANICAL IDENTIFICATION MATERIALS

- A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 23 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.3 PLASTIC PIPE MARKERS

- A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.
- B. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, and pressure-sensitive vinyl pipe markers, complying with ANSI A13.1.
- C. Insulation: Furnish 1 inch thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on un-insulated pipes subjected to fluid temperatures of 125°F (52°C) or greater. Cut length to extend 2 in. beyond each end of plastic pipe marker.
- D. Small Pipes: For external diameters less than 6 in. (including insulation if any), provide full-band pipe markers, extending 360° around pipe at each location, fastened by one of the following methods:
 - 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - 2. Adhesive lap joint in pipe marker overlap.
 - 3. Laminated or bonded application of pipe marker to pipe (or insulation).
 - 4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4 in. wide; full circle at both ends of pipe marker, tape lapped 1-1/2 in.
- E. Large Pipes: For external diameters of 6 in. and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
 - 1. Laminated or bonded application of pipe marker to pipe (or insulation).
 - 2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 in. wide; full circle at both ends of pipe marker, tape lapped 3 in.

3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.
- F. Lettering: Manufacturer's standard pre-printed nomenclature that best describes piping system in each instance, as selected by Architect in cases of variance with name as shown or specified.
- G. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.
1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.4 PLASTIC DUCT MARKERS

- A. General: Provide manufacturer's standard laminated plastic, color-coded duct markers. Conform to the following color code:
1. Green: Cold air.
 2. Yellow: Hot air.
 3. Yellow/Green: Supply air.
 4. Blue: Exhaust, outside, return, and mixed air.
 5. For hazardous exhausts, use colors and designs recommended by ANSI A13.1.
- B. Nomenclature: Include the following:
1. Direction of airflow.
 2. Duct service (supply, return, exhaust, etc.).
 3. Duct origin (from).
 4. Duct destination (to).
 5. Design CFM.

2.5 VALVE TAGS

- A. Brass Valve Tags: Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4 in. high letters and sequenced valve numbers 1/2 in. high, and with 5/32 in. hole for fastener.
1. Provide 1+ in. diameter tags, except as otherwise indicated.
 2. Provide size and shape as specified or scheduled for each piping system.
 3. Fill tag engraving with black enamel.

- B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.
- C. Access Panel Markers: Provide manufacturer's standard 1/16 in. thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8 in. center hole to allow attachment.

2.6 VALVE SCHEDULE FRAMES

- A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.7 ENGRAVED PLASTIC-LAMINATE SIGNS

- A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
- B. Thickness: 1/16 in. for units up to 20 sq. in. or 8 in. length; 1/8 in. for larger units.
- C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.8 LETTERING AND GRAPHICS

- A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
 - 1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification that indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordination: Where identification is to be applied to surfaces that require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 DUCTWORK IDENTIFICATION

- A. General: Identify air supply, return, exhaust, intake and relief ductwork with duct markers; or provide stenciled signs and arrows, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color).

- B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50' spacings along exposed runs.
- C. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.
- D. Concealed Doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticize tags may be installed for identification in lieu of specified signs, at Installer's option.

3.3 PIPING SYSTEM IDENTIFICATION

- A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:
 - 1. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.
- B. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
 - 1. Near each valve and control device.
 - 2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
 - 3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures on both sides of penetration.
 - 4. At access doors, manholes and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced intermediately at maximum spacing of 20 ft. along each piping run, except reduce spacing in congested areas of piping and equipment, where required for clarity.
 - 7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.
- C. Piping Identification
 - 1. Provide piping identification for the following:

a. System	Background Color	Text Color
b. Chilled Water Supply	Green	White
c. Chilled Water Return	Green	White
d. Heating Water Supply	Green	White

- e. Heating Water Return Green White

3.4 VALVE IDENTIFICATION

- A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.
 - 1. Tagging Schedule: Comply with requirements of "Valve Tagging Schedule" at end of this section.
- B. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect.
 - 1. Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than single machine room.

3.5 MECHANICAL EQUIPMENT IDENTIFICATION

- A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
 - 1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - 2. Meters, gauges, thermometers and similar units.
 - 3. Fuel-burning units including boilers, furnaces, heaters, stills and absorption units.
 - 4. Pumps, compressors, chillers, condensers and similar motor-driven units.
 - 5. Heat exchanger, coils, evaporators, cooling towers, heat recovery units and similar equipment.
 - 6. Fans, blowers, primary balancing dampers and mixing boxes.
 - 7. Packaged HVAC central-station and zone-type units.
 - 8. Tanks and pressure vessels.
 - 9. Strainers, filters, humidifiers, water treatment systems and similar equipment.
- B. Lettering Size: Minimum 1/4 in. high lettering for name of unit where viewing distance is less than 2 ft. 0 in., 1/2 in. high for distances up to 6 ft. 0 in., and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.
- C. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.6 ADJUSTING AND CLEANING

- A. Adjusting: Relocate any mechanical identification device, which has become visually blocked by work of this division or other divisions.
- B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

3.7 EXTRA STOCK

- A. Furnish minimum of 5% extra stock of each mechanical identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.
 - 1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

END OF SECTION

**SECTION 230719
HVAC PIPING INSULATION**

PART 1 - GENERAL

1.1 SUMMARY

- A. Extent of mechanical insulation required by this section is indicated on Drawings and schedules, and by requirements of this section.
- B. Types of mechanical insulation specified in this section include the following:
 - 1. Piping System Insulation:
 - a. Fiberglass.
 - b. Flexible Unicellular.
- C. Refer to Section 220529 "PLUMBING SUPPORTS AND ANCHORS" for protection saddles, protection shields, and thermal hanger shields; not work of this section.
- D. Refer to Section 233113 "METAL DUCTWORK" for duct linings; not work of this section.
- E. Refer to Section 230553 "MECHANICAL IDENTIFICATION" for installation of identification devices for piping, ductwork, and equipment; not work of this section.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.
- C. Flame/Smoke Ratings: Provide composite mechanical (insulating material, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.
- B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. Babcock & Wilcox; Insulating Products Div.
 - 3. CertainTeed Corp.
 - 4. Knauf Fiber Glass.
 - 5. Johns Manville Products Corp.
 - 6. Owens-Corning Fiberglass Corp.
 - 7. Pittsburgh Corning Corp.

2.2 PIPING INSULATION MATERIALS

- A. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated.
- B. Flexible Unicellular Piping Insulation: ASTM C 534, Type I.
- C. Jackets for Piping Insulation: ASTM C 921, Type I (Vapor Barrier) for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installer's option.
 - 1. Encase pipe fittings insulation with one-piece pre-molded PVC fitting covers, fastened as per manufacturer's recommendations.
 - 2. Encase exterior piping insulation with aluminum jacket with weather-proof construction.
- D. Staples, Bands, Wires and Cement: As recommended by insulation manufacturer for applications indicated.
- E. Adhesives, Sealers and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

2.3 METAL PROTECTIVE JACKET

- A. Sheet aluminum: ASTM B209, 3003 alloy, H-14 temper, and 0.016 in. thick. Provide moisture barrier lining for service temperatures 60°F or less except where applied over a Type I or II jacket. Longitudinal lap shall be at least two inches wide.
- B. Stainless Steel: ASTM A-240, manufactured from T-304 prime grade Stainless Steels, supplied with a regular dull finish for reduced glare and 0.016 in. thick. These alloys shall be of a soft-annealed temper, for ease in fabrication. Jacketing shall be used for insulated piping, tanks, and vessels less than 8 ft. in diameter. Deep corrugated sheets shall be used for diameters greater than 8 ft. Roll jacketing shall be 3/16 in. corrugated.

- C. Fitting covers: Factory fabricated from not lighter than 0.020 in. thick type 3003 sheet aluminum.
- D. Bands: 3/4 in. wide aluminum on maximum 18 in. centers.
- E. Provide metal jackets over insulation as follows:
 - 1. All insulation exposed to outdoor weather.
 - 2. Insulation exposed in building within five (5) ft. of the floor that connect to sterilizers, kitchen and laundry equipment. Jackets may be applied with pop rivets. Provide aluminum angle ring escutcheons at wall, ceiling and floor penetrations.
 - 3. A two-inch overlap is required at longitudinal and circumferential joints.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.
- B. Thickness of insulation shall be as recommended by the manufacturer for the temperatures and pipe sizes involved, and in accordance with standards of T.I.M.A.

3.2 HVAC PIPING SYSTEM INSULATION

- A. Insulation Omitted: Omit insulation on hot piping within radiation enclosures or unit cabinets; on cold piping within unit cabinets provided piping is located over drain pan; on heating piping beyond control valve, located within heated space; on condensate piping between steam trap and union; and on unions, flanges, strainers, flexible connections and expansion joints.
- B. Sub-Freezing Piping (0 to 39°F (-18 to 4°C)):
 - 1. Application Requirements: Insulate the following subfreezing HVAC piping systems:
 - a. Refrigerant suction lines between evaporators and compressors. Brine refrigerant piping.
 - 2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
 - a. Fiberglass: 1 in. thick for pipe sizes up to and including 1 in., 1-1/2 in. thick for pipe sizes over 1 in.
- C. Cold Piping (40°F (4.4°C) to ambient)):
 - 1. Application Requirements: Insulate the following cold HVAC piping systems:
 - a. HVAC chilled water supply and return piping.
 - b. HVAC make-up water piping.
 - c. Air conditioner condensate drain piping.

2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
 - a. Fiberglass: 1 in. thick for pipe sizes up to and including 1-1/2 in., 1-1/2 in. thick for pipe sizes over 1-1/2 in.
 - b. Flexible Unicellular: 1/2 in. thick for pipe sizes up to 1-1/2 in. (largest size permitted).
- D. Hot Low Pressure Piping (to 248°F (120°C)):
 1. Application Requirements: Insulate the following hot low-pressure HVAC piping systems (steam piping up to 14 psi water piping up to 248°F (120°C)).
 - a. Hot gas refrigerant piping.
 2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
 - a. Fiberglass: 1-1/2 in. thick for pipe sizes up to and including 1-1/2 in., 2 in. thick for pipe sizes 1-1/2 in.
- E. Insulation of Piping Exposed to Weather: Protect outdoor insulation from weather by installing outdoor protective finish or jacketing as recommended by the manufacturer.

3.3 INSTALLATION OF PIPING INSULATION

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- E. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.
- F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.
- G. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.
- H. Do NOT insulate over pipe hangers. If pipe hangers for piping to be insulated are not adequately sized for insulation to pass through the hanger, notify the General Contractor and Architect.

3.4 INSULATION EXPOSED TO WEATHER

- A. Protect outdoor insulation from weather by installation of weather-barrier metal jacketing. Metal jacketing shall be Aluminum. It may be factory-applied or field applied. Joints shall be overlapped a minimum of 2 in. Securement shall be accomplished by using screws, rivets, or stainless steel bands. Any vapor-barrier jacket or coating under the metal jacketing shall not be disturbed or punctured by the use of screws or rivets on the outer jacket.

3.5 EXISTING INSULATION REPAIR

- A. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation of same thickness as existing insulation, install new jacket lapping and sealed over existing.

3.6 PROTECTION AND REPLACEMENT

- A. Replace damaged insulation that cannot be repaired satisfactorily, including units with vapor barrier damage and moisture-saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

**SECTION 232113.23
HYDRONIC PIPING**

PART 1 - GENERAL

1.1 SUMMARY

- A. Extent of hydronic piping work is indicated on drawings and schedules, and requirements of this section.
- B. This section includes pipe, fittings, and valves for hydronic piping systems installed in the project as follows:
 - 1. Chilled Water.
 - 2. Miscellaneous Drain Lines.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of hydronic piping products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with hydronic piping work similar to that required for project.
- C. Codes and Standards:
 - 1. ASME Compliance: Fabricate and install hydronic piping in accordance with ASME B31.9 "Building Services Piping".
 - 2. IMC Compliance: Fabricate and install hydronic piping in accordance with "International Mechanical Code."

1.3 SUBMITTALS

- A. Provide the following submittals in accordance with Division 01 and Section 230010.
- B. Product Data: Submit manufacturer's technical product data and installation instructions for hydronic piping materials and products.
- C. Submit certificates as listed below:
 - 1. Test Certificates of Approval for Piping Systems.
- D. Record Drawings: At project closeout, submit Record Drawings of installed hydronic piping and piping products, in accordance with requirements of Division 01.

1.4 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS - GENERAL

- A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements.
- B. Provide materials and products complying with ASME B31.9 Code for Building Services Piping where applicable, base pressure rating on hydronic piping systems maximum design pressures.
- C. Provide sizes and types as required to match piping and equipment connections; provide fittings of materials which match pipe materials used in hydronic piping systems.
- D. Where more than one type of material or product is indicated, selection is Installer's option.

2.2 BASIC PIPES AND PIPE FITTINGS

- A. Hydronic Piping:
 - 1. Tube Size 3 in. and Smaller: ASTM B88 copper tube; Type L, hard-drawn temper; wrought-copper fittings, ANSI/ASME B16.27 with soldered joints, ANSI/ASTM B32, Grade 95TA.
 - 2. Pipe Size 2-1/2 in. and Larger: ASTM A53 black steel pipe; Schedule 40; wrought-steel butt welding standard weight fittings, ASTM A234 and ANSI/ASME B16.9 with welded joints, ANSI/ASME B16.25.
 - 3. Pipe Run within Concrete Construction: Copper tube; Type K, soft annealed temper; no joints or fittings allowed. Sleeve tube with continuous length of 3/8 in. minimum thickness of flexible unicellular insulation.
 - 4. Hydronic Drain Piping: Copper pipe; ASTM B306, DWV fittings; ANSI/ASME B16.3, cast bronze, or AWSI/ASME B16.29, wrought copper. Joints: ANSI/ASTM B32, solder, Grade 50B.

2.3 FLANGES, UNIONS AND COUPLINGS

- A. Pipe Size 2 in. and under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.
- B. Pipe Size Over 2 in.: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; gaskets suitable for intended service – NO ASBESTOS GASKET MATERIAL ALLOWED.
- C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, and water impervious isolation barrier.

2.4 BASIC VALVES

- A. Globe Valves: For throttling.
 - 1. Globe valves 2 in. and less: MSS SP-80, rated for 200 psig minimum water pressure, bronze body and disc, plug type disc, graphite fiber packing, thread bonnet, threaded connections.

a. Acceptable Manufacturers and Models:

- 1) Apollo 121T
- 2) Crane 1
- 3) KITZ 11
- 4) Milwaukee 502
- 5) Nibco T-211-Y
- 6) Stockham B-16

2. Globe valves 2-1/2 in. and greater: MSS SP-85, rated for 200 psig minimum water pressure, iron body bronze mounted, renewable bronze seat and disc, graphite fiber packing, bolted bonnet, flanged connections.

a. Acceptable Manufacturers and Models:

- 1) Apollo 711F
- 2) Crane 351
- 3) KITZ 76
- 4) Milwaukee F2981
- 5) Nibco F-718-B
- 6) Stockham G-512

B. Ball Valves: For shutoff and throttling.

1. Ball valves 2 in. and less: MSS SP-72, rated for 200 psig minimum water pressure, full port, forged brass, bronze or stainless steel body, 316 or 304 stainless steel ball and stem, reinforced Teflon seats and seals, threaded or soldered connections. Throttling valves shall be provided with memory stops (for establishing any setpoint from 0-100% flow).

a. Acceptable Manufacturers and Models:

- 1) Apollo 77-100 Series
- 2) Jomar T-100-SS
- 3) KITZ 68M
- 4) Nibco T-585-70-66
- 5) Victaulic Series 722
- 6) Watts B-6080, B-6081

2. Ball valves 2 in. and less with PEX connections: MSS SP-72, rated for 200 psig minimum water pressure, full port, brass construction, 316 or 304 stainless steel ball and stem, reinforced Teflon seats and seals, lever handle, ASTM F1960 PEX connections.

- a. Acceptable Manufacturers and Models:

- 1) Legend T-1960NL
- 2) Uponor A320

3. Ball valves 2-1/2 in. and greater: MSS SP-72, rated for 200 psig minimum water pressure, full port, cast iron, bronze or stainless steel body, 316 or 304 stainless steel ball and stem, reinforced Teflon seats and seals, flanged connections. Throttling valves shall be provided with memory stops (for establishing any setpoint from 0-100% flow).

- a. Acceptable Manufacturers and Models:

- 1) Apollo 6PLF
- 2) Crane KF 953
- 3) Jomar T-100-SS (NPT) or FL-CS-100-150 (FLANGED)
- 4) KITZ 90
- 5) Nibco T-585-70-66
- 6) Victaulic Series 727
- 7) Watts G 4000

C. Butterfly Valves: For shutoff and throttling.

1. Butterfly valves 2-1/2 in. and larger: MSS SP-67, rated for 200 psig minimum water pressure, full lug style with threaded connections (rated for dead end service), iron body, stainless steel stem, EPDM seat material, gear operator with wheel, for flanged connections. Throttling valves shall be provided with memory stops (for establishing any setpoint from 0-100% flow).

- a. Acceptable Manufacturers and Models:

- 1) Apollo LD141
- 2) Crane 42
- 3) Jomar 600/900
- 4) KITZ 6123E, 6121E
- 5) LD-2000-3 (Lever operated)
- 6) LD-2000-5 (8" and above gear operated)
- 7) Milwaukee ML Series
- 8) Stockham LG-522

9) Victaulic Vic-300 MasterSeal

10) Watts BF-03

D. Check Valves

1. Check valves 2 in. and less: MSS SP-80, rated for 200 psig minimum water pressure, swing type, bronze body and disc, renewable seat disc, threaded cap, threaded connections.

a. Acceptable Manufacturers and Models:

1) Apollo 163T/S

2) Crane 37

3) Jomar T/S-511

4) KITZ 22T

5) Milwaukee 509

6) Nobco T-413-Y

7) Stockham B-319

2. Check valves 2-1/2 in. and greater: MSS SP-71, rated for 200 psig minimum water pressure, swing type, iron body bronze mounted, bolted cap, flanged connections.

a. Acceptable Manufacturers and Models:

1) Apollo 910F

2) Crane 373

3) KITZ 78

4) Milwaukee F2974

5) Nibco F-918-B

6) Stockham G-931

7) Victaulic 716 / 779

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which hydronic piping systems materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

- B. Prior to and during the installation of grooved piping systems, the grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and the installation of all grooved-end products. The manufacturer's representative shall periodically visit the jobsite to review and inspect installations. Contractor shall remove and replace any joints deemed improperly installed. All grooving tools and products shall be of the same manufacturer.

3.2 INSTALLATION OF HYDRONIC PIPING

- A. General: Install hydronic piping in accordance with the following requirements:
 - 1. Install eccentric reducers where pipe is reduced in size in direction of flow, with tops of both pipes and reducer flush.
 - 2. Connect branch-feed piping to mains at horizontal centerline of mains; connect run-out piping to branches at horizontal centerline of branches.
 - 3. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
 - 4. Install dielectric connections wherever joining dissimilar metals.
- B. Roof penetrations through metal roofs by the Plumbing or Mechanical Contractor will be required to have written approval by the Roofing Contractor.

3.3 INSTALLATION OF VALVES

- A. Provide gate, ball, or butterfly valves for shutoff service as follows:
 - 1. On each branch riser, close to main, where branch or riser serves 2 or more hydronic terminals or equipment connections, and elsewhere as indicated.
 - 2. On inlet and outlet of each mechanical equipment item, and on inlet of each hydronic terminal, and elsewhere as indicated.
 - 3. As drain valves on each mechanical equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop in piping system, and elsewhere where indicated or required to completely drain hydronic system.
- B. Provide globe, ball, or butterfly valves for throttling service as follows:
 - 1. On outlet of each hydronic terminal, and elsewhere as indicated.
- C. Provide check valves on discharge side of each pump, and elsewhere as indicated.
 - 1. Horizontal swing check valve shall be installed in a true horizontal position.

3.4 EQUIPMENT CONNECTIONS

- A. General: Connect hydronic piping system to mechanical equipment as indicated, and comply with equipment manufacturer's instructions where not otherwise indicated. Install shutoff valve and union on supply and return, drain valve on drain connection.

- B. Hydronic Terminals: Install hydronic terminals with hydronic terminal outlet valve and union on outlet; union, shutoff valve on inlet. Install manual air vent valve on element in accordance with manufacturer's instructions. Locate valves and balancing cocks behind valve access doors for ease of maintenance. Where indicated, install automatic temperature control valve with unions between gate valve and element on supply line.

3.5 TESTING

- A. General: Furnish pumps, gauges, equipment, and personnel required, and test as necessary to demonstrate the integrity of the furnished installation.
- B. Pressure Piping: Hydrostatically test and make tight at 1-1/2 times the normal operating pressure and not less than 150 psig. Repair leaking joints and retest.
- C. Gravity Piping: Unless otherwise directed, plug all openings and fill with water to a height equal to highest connected equipment. Allow to stand one hour. Remake leaking joints and retest.
- D. Tests and Test Procedures shall be witnessed and approved by the Architect.
- E. After completion and approval of testing, submit "Test Certificates of Approval" for heating water, chilled water, and condenser water piping systems stating that all test results are satisfactory. Certificates of Approval must be signed by Contractor and Architect.

3.6 CLEANING

- A. Cleaning, Flushing and Inspecting: Flush hydronic piping with potable water until the system can operate for eight (8) hours without partial build-up in strainers.
- B. Chemical Treatment: Refill hydronic piping systems, adding caustic soda to maintain pH of 8.0 to 8.5 and sodium sulfate in amount of 1/3 caustic soda or to maintain residual of 30- to 40-ppm in system. Add trisodium phosphate to make hardness of 0-ppm and residual of approximately 30-ppm in system. Repeat measurements daily with system under full circulation and apply chemicals to adjust levels until no change is apparent.
 - 1. Coordinate chemical treatment of the hydronic systems after installation of new piping and filling/re-filling of system with the Owner's Water Treatment Supplier. The additional chemicals required due to cleaning and filling/re-filling of the hydronic systems are a part of this project, and the responsibility of the Contractor.

3.7 TESTING, ADJUSTING AND BALANCING

- A. Test, adjust and balance hydronic systems in accordance with requirements of Section 230593.

END OF SECTION

SECTION 238127
DUCTLESS SPLIT AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 GENERAL

- A. All work shall be in accordance with the "General Conditions", "Supplemental Conditions" and the "General Requirements for Mechanical Work".
- B. All work shall be in accordance with City Building, Plumbing and Mechanical Codes and with all state and national codes as they may apply to the project and to public safety.

1.2 SCOPE OF WORK

- A. It is the intent that the contractor shall install a complete and operable air conditioning system, fully adjusted and ready for use.
- B. Materials and equipment have been carefully selected for the project. The Contractor is expected to furnish and install items that the specification required as closely as possible.
- C. The drawings accompanying these specifications show the extent of the HVAC work and the general arrangement. The drawings, however, are diagrammatic and exact layout of the systems is the responsibility of the Contractor.
- D. The Contractor shall pay all fees and charges to City or other agencies.

1.3 HVAC SUBMITTAL

- A. The Contractor shall check all items of submittal data and verify by statement and initial that each item has been checked for the following conditions:
 - 1. Item is equal to specified item in construction and quality.
 - 2. Item is of the same physical size. If not of the same physical size, the dimensions have been checked and item will fit within the allocated space shown on the drawings. Where items proposed are different than scheduled item, furnish 1/4 in. scale plan and 1/4 in. sections on tracing paper (for direct overlay) of proposed equipment including space required for connections or service. The tracing of 1/4 in. plans and 1/4 in. sections must be furnished in submittal for other than scheduled equipment in order to compare proposed equipment with scheduled equipment.
 - 3. System connections to the item can be made as shown on the drawings.
 - 4. Shop drawings show in detail all connections, etc., required to meet the overall specifications in every detail.
 - 5. Statement of guarantee that the proposed equipment shall operate properly as applied to the project and will not require additional devices or changes in the installation shown on the drawings.
- B. Complete specification data shall be submitted for all HVAC items, including the list below:
 - 1. Ductless Split Air Conditioning Units

- C. When equipment other than specified is proposed, the Contractor shall be responsible for the proper design and installation of electrical power to equipment. Submit listing of electrical feeder size, conduit size, breaker size, etc., for each item of equipment for review.

PART 2 - MATERIALS

2.1 DUCTLESS SPLIT AIR CONDITIONING UNITS

- A. General - Furnish and install an indoor ductless fan coil unit and outdoor condensing unit. The unit shall be shipped completely factory assembled, piped and wired internally ready for field connections. In addition, manufacturer shall test operate unit at the factory before shipment. The equipment shall be standard products of a firm regularly engaged in the manufacturer of heating-cooling equipment. The manufacturer shall have parts and service available throughout the United States.
- B. Unit Capacity - The total cooling capacity and total heating capacity shall be as scheduled.
- C. Compressor - Units shall be single speed compressors or two speed compressors providing staging control to deliver varying cooling load requirements. Compressor shall be resiliently mounted, suction cooled, overload protected, internal pressure relief protected and have internal excessive current and temperature protection. Units shall have vertical crankshaft, ringed valves and piston, tuned discharge muffler, efficient oil pump and crankcase heater.
- D. Refrigerant System - Shall include liquid line service valve, suction line service valve, gauge ports, hi-capacity drier, thermometer well, high and low pressure switches and timed-off control.
- E. Condenser Coil(s) - Coil(s) shall be non-ferrous construction with aluminum fins mechanically bonded to durable copper tubes. Coil(s) shall be pressure leak tested. Coil(s) shall be protected with expanded metal type hail guard(s).
- F. Air Mover - Shall be direct blade type fan(s). Motor(s) shall have inherent protection devices and shall be protected from moisture. Fan(s) shall be protected with steel guard(s).
- G. All wiring shall be in compliance with NEC. All wiring shall be rated in accordance with ARI Standard 210-81 and 360-86. Units shall have UL listing. Units shall have ETL Testing Laboratories listing where applicable.
- H. Indoor unit cabinet shall be of a durable ABS plastic with a galvanized steel sub-chassis. The filter shall be nylon mesh, easily accessible, washable and reusable. Unit shall have manually adjustable discharge fins. Unit shall be wall mounted with all pipe connections accessible from the cabinet. There shall be a removable end-cap for access to controls and for servicing.
- I. Condensate drain pan shall be made of galvanized steel and shall come with an anti-corrosion coating.
- J. A condensate pump shall be provided and installed for the indoor unit.
- K. Warranty - The compressor shall have a warranty for five years. All other components shall have a warranty for one year.
- L. Acceptable manufacturers:
 - 1. Mitsubishi

2. Samsung
3. Daikin
4. LG
5. Trane

2.2 REFRIGERANT PIPING

- A. Pipe material shall be Type "L" copper tubing, hard drawn with copper solder type fittings suitable for connection with silver solder. Soft drawn copper "pre-charged" refrigerant piping should be acceptable for split-system units where developed length between evaporator and condensing unit is within manufacturer guidelines.
- B. All piping shall be installed parallel or perpendicular to the building construction. All piping shall be installed so as to allow for expansion.
- C. When "pre-charged" piping is not used, all piping joints shall be made with silver solder. The piping shall be charged with dry nitrogen while constructing the joints. A removable type drier strainer shall be installed in the liquid line. After the Freon piping has been completed, the refrigerant system shall be pressured tested at a pressure of 300 psi (high side) and 150 psi (low side). While the system is being pressure tested, an electronic leak detector shall be used to check for leaks. Pressure shall be maintained on the system for a minimum of 12 hours. The system shall be evacuated when the surrounding ambient air is not less than 60°F. A minimum vacuum of 2.0mm of mercury shall be pulled on the system and maintained for 12 hours. The vacuum pressure displacement shall be not less than 5 CFM. The vacuum shall be checked with an electronic gauge.
- D. All pipes shall be supported from the building structure in a neat and workmanlike manner, and wherever possible, parallel runs of horizontal piping shall be grouped together on trapeze type hangers. The use of wire or perforated metal to support pipes will not be permitted. Hanging pipes from other pipes will not be permitted. Spacing of pipe supports shall not exceed 8 ft. for pipes up to 1-1/4 in. and 10 feet on all other piping. Hangers shall pass around the insulation and an 18 gauge steel protective band, 12 in. long, shall be inserted between the hangers and the insulation.
- E. Insulation material shall be 1 in. thick for all pipe sizes up to and including 1-1/2 in., 1-1/2 in. thick for all pipe sizes over 1-1/2 in., foamed plastic, heavy density, J-M Aero tube, or approved equal. All refrigerant suction piping shall be insulated. Pipe insulation shall have a flame spread rating of not over 25, 50 smoke developed and 50 fuel contributed. Verify insulation requirements with code when installed in return air plenum spaces.
- F. All pipe insulation shall be applied over clean, dry surfaces, butting adjoining sections firmly together. All fittings shall be installed and finished in strict accordance with manufacturer's recommendations. Insulation exposed to weather shall have waterproof and UV resistant covering.
- G. Piping shown to be routed underground shall be contained within PVC piping sleeve.

PART 3 - INSTALLATION

3.1 EXAMINATION

- A. Examine areas and conditions under which units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION

- A. General: Install units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- B. Electrical Connections: Coordinate with Electrical for final connections to equipment and installation of loose-shipped electrical components.

3.3 DEMONSTRATION

- A. Start-Up Services: Provide the services of a factory-authorized service representative to start-up units, in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- B. Operating and Maintenance Training:
 - 1. Provide services of manufacturer's service representative to instruct Owner's personnel in operation and maintenance of units. Training shall consist of a minimum of 8 hours, not necessarily consecutive, and shall include start-up and shutdown, servicing and preventative maintenance schedule and procedures, and troubleshooting procedures plus procedures for obtaining repair parts and technical assistance. Review operating and maintenance data contained in the Operating and Maintenance Manuals specified in Division 01.

END OF SECTION

**SECTION 260510
GENERAL REQUIREMENTS FOR ELECTRICAL WORK**

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide all labor, materials, supervision, tools, services, equipment and incidentals necessary for complete and operational systems as specified under this division and as shown on the Contract Drawings.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Division.

1.2 DRAWINGS AND SPECIFICATIONS

- A. Prior to submitting a bid:
 - 1. Examine the Drawings.
 - 2. Read the Specifications and other Contract Documents, including Addenda and referenced material.
 - 3. Visit the site of the work.
 - 4. Become informed prior to bidding as to existing conditions and limitations of the project.
- B. Bring exceptions and inconsistencies in Drawings, specifications, addenda, referenced material, other Contract Documents and site conditions to the attention of the Architect in writing seven days before the bid opening; otherwise be responsible for changes and additions that become necessary during construction.
- C. Interpretation or correction of the Contract Documents will be made by Addendum and will be mailed or delivered to each Contract Bidder of Record.
- D. Location of material, equipment, devices and appliances shown in the Contract Drawings are approximate and are subject to such revisions as may be necessary or desirable at the time the work is installed. Install the work in relation to existing conditions and be responsible for the correctness of the work with reference to finish elevations and surrounding conditions.
- E. The Contract Documents show the general arrangements of the work. Should project conditions require any rearrangement, or if equipment or accessories can be installed to better advantage in a different manner, the Contractor may, before proceeding with the work, prepare and submit five copies of shop drawings of the proposed rearrangement for the Architect's review.
- F. If the Contractor proposes to install equipment requiring space conditions other than those shown, he shall assume responsibility for the rearrangement of the space and shall have the Architect review the change before proceeding with the work. The request for such changes shall be accompanied by shop drawings of the space affected.
- G. The accompanying Drawings do not indicate the existing electrical installations other than to identify modifications and extensions thereto. Visit the site and ascertain the conditions to be

met and the work to be accomplished in removing and modifying the existing work, and installing the new work. Failure to comply with this shall not constitute grounds for any additional payment in connection with removing or modifying any part of the existing installations and/or installing any new or temporary work under this Division.

1.3 CODES AND STANDARDS

- A. Execute the work in accordance with local, state and national codes, ordinances and regulations having jurisdiction or authority over the work. Make any and all adjustments required by these agencies without further cost to the Owner. In addition, conform to the applicable provisions and recommendations of the following standards:
 - 1. National Electrical Manufacturer Association (NEMA)
 - 2. American Society for Testing and Materials (ASTM)
 - 3. National Fire Protection Association (NFPA)
 - 4. National Electrical Safety Code (NESC)
 - 5. Institute of Electrical and Electronic Engineers (IEEE)
 - 6. National Electrical Code (NEC)
 - 7. Underwriters' Laboratories (UL)
 - 8. American National Standards Institute (ANSI)
 - 9. International Building Code (IBC)
 - 10. Occupational Safety and Health Administration (OSHA)
 - 11. Americans with Disabilities Act (ADA)
 - 12. Applicable utility companies
 - 13. Texas Accessibility Standards (TAS)
 - 14. International Energy Conservation Code (IECC)
- B. Execute the work in accordance with the most current codes and standards in effect at the time of bidding.
- C. In the event standards and codes conflict with each other, the most stringent shall apply.
- D. Conform to National Electrical Code rules. Provide material and equipment, which is approved by Underwriter's Laboratories, bears UL label and is acceptable to Factory Mutual.
- E. It is specifically understood, however, that in those instances where capacities, sizes, etc., of electrical equipment, devices or material as designated in these Specifications or on the Drawings are in excess of the minimum requirements of the National Electrical Code, such designated capacities shall prevail.

PART 2 - PRODUCTS

2.1 SHOP DRAWINGS AND SUBMITTALS

- A. Submit Shop Drawings for all material furnished under this division of the work. Refer to the General Requirements for additional requirements. In addition to the quantity of Shop Drawing copies required by the General Requirements, furnish one additional copy for the Electrical Engineer's file. No material shall be fabricated, delivered to the jobsite, or installed which the Architect through Shop Drawing submittals has not approved.
- B. The submittals shall include sufficient descriptive material, such as catalog cuts, diagrams, and other data published by the manufacturer, as well as evidence of compliance with safety and performance standards, to demonstrate conformance to the specification requirements; catalog numbers alone will not be acceptable. The data shall include the name and address of the nearest service and maintenance organization that regularly stocks repair parts.
- C. Deliver Shop Drawings to the Architect in sufficient time to avoid delay of the project. Group Division 26 submittals as identified below, submit sections not included in these groupings separately. The Electrical Contractor shall acknowledge receipt of all Division 23 mechanical equipment submittals and confirm the overcurrent protection requirements of the project specific HVAC equipment has been coordinated with the distribution equipment prior to submitting for approval. All proposed changes to the overcurrent protection devices shall be clearly identified in the distribution equipment submittal.
 - 1. Distribution Equipment – Low Voltage
 - a. Section 262213 - DRY TYPE TRANSFORMERS
 - b. Section 262416 - PANELBOARDS
 - c. Section 262417 - DISTRIBUTION PANELBOARDS
 - d. Section 262716 - CABINETS
 - e. Section 262816 - OVERCURRENT PROTECTIVE DEVICES
 - f. Section 262817 - DISCONNECT SWITCHES
 - g. Section 262913 - MOTORS, MOTOR STARTERS AND CONTROLS
 - 2. Lighting
 - a. Section 260924 - OCCUPANCY SENSORS
 - b. Section 265113 - LIGHTING
- D. Submit samples for approval when requested by the Architect.
- E. Before submitting Shop Drawings for review, examine them and verify that they correctly represent the material or equipment intended for this project. The Contractor's review of Shop Drawings is not intended to take the place of the review of the Architect, and Shop Drawings which have not been reviewed by the Architect shall not be used in fabricating or installing any work.

- F. List deviations and exceptions from the specified equipment in writing. Failure to do so will be cause for rejection of submittals. Contractor agrees that if deviations, discrepancies, or conflicts between Shop Drawing submittals and the Contract Documents are discovered either prior to or after Shop Drawing submittals are reviewed by the Architect, the Contract Documents shall control and shall be followed, unless deviations have been specifically approved by the Architect.
- G. The review of Shop Drawings or catalog data by the Architect shall not relieve the Contractor from responsibility for deviations from plans and specifications unless he has, in writing, specifically called attention to such deviations at the time of submission and has obtained the permission of the Architect thereon; nor shall it relieve him from responsibility for error of any kind in Shop Drawings. When the Contractor does call such deviations to the attention of the Architect, he shall state in his letter whether or not such deviations involve any extra cost. If this is not mentioned, it will be assumed that no extra cost is involved for making the change.
- H. Contractor agrees that Shop Drawing submittals reviewed by the Architect are not change orders; that the purpose of Shop Drawing submittals by the Contractor is to demonstrate to the Architect that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use.

2.2 STANDARDS FOR MATERIALS

- A. It is the intention of these specifications to indicate a standard of quality for all materials incorporated in this work. Manufacturer's names and catalog numbers are used to designate the item of equipment or material as a means of establishing grade and quality. Where several manufacturers are named, only the named manufacturer's products will be considered and the Contractor's bid shall be based on their product.
- B. Where the phrase 'or approved equivalent' or 'or equivalent' or 'equivalent to' or 'accepted substitute' is used in these specifications, the names or name mentioned are to be used as a basis of quality. Other manufacturers will be considered if the quality of the proposed material is equivalent to that of materials named, in the opinion of the Architect. Such unnamed manufacturers' products will, however, be considered as substitutions and shall not be used as a basis for bidding.
- C. Basis of quality shall include material, workmanship, weight, finishes, and gauges of material, appearances, capacity and performance. Manufacturer's representation as to availability of equipment, replacement parts and service personnel in the area will be a factor in consideration of submittals.
- D. All materials shall be fully warranted.
- E. Furnish standard products and manufacturers regularly engaged in production of such equipment.
- F. Furnish manufacturer's latest standard design.
- G. All equipment shall conform with applicable IEEE, UL, ANSI and/or NEMA Standards.

- H. Obtain manufacturer's recommendations and instructions for all installed equipment including installation instructions, preparation cleaning, tests and preservice checks, and then ensure all have been performed prior to completion of work.

2.3 SUBSTITUTIONS

- A. The Architect prior to installation shall approve substitutions of equipment. Substitution of equipment shall be in accordance with Division 01 of the specifications.
- B. When alternate or substitute materials and equipment are used, the Contractor shall be responsible for space requirements, configurations, performance, changes in bases, supports, structural members and openings in structure, and other apparatus and trades that may be affected by their use.
- C. Contractor shall bear all additional costs resulting from the use of substituted materials. Such changes shall be at no additional cost to the Owner.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Coordinate and direct the work under this division of the specifications with the work under other divisions of the specifications. Examine the Contract Documents and report any discrepancies between divisions of the work to the Architect and obtain written instructions for changes necessary in the work.
- B. Before installation, make proper provisions to avoid interferences with the work under other divisions of the specifications. Changes required in the work of the Contractor caused by his neglect to do so shall be made by him at his own expense.
- C. Harmonize the work under this division with the work under other divisions of the specifications such that it may be installed in the most direct and workmanlike manner without hindering, handicapping, or conflicting with the work under other divisions of the specifications. Piping interferences shall be handled by giving precedence to pipelines that require a stated grade for proper operation.

3.2 PERMITS AND FEES

- A. Secure and pay for all necessary permits, licenses and inspections required by law for the completion of the Work. Secure and pay for all certificates of approval that are required and deliver them to the Architect before final acceptance of the Work.
- B. If a utility company in connection with the work under this division makes any charges, the Contractor shall advise the Owner, so that the Owner can pay these charges. Advise the Owner of these charges in a timely manner, so as not to delay construction of the project.

3.3 QUALITY ASSURANCE

- A. Use adequate quantities of skilled workmen who are trained and experienced in their crafts and who are familiar with the specified requirements and methods needed to perform the work in this division.

- B. Install materials and equipment based upon actual dimensions and conditions at the project site. Field measure for materials or equipment requiring exact fit.
- C. Be responsible for the proper location and sizes of all slots, holes or openings in the building structure pertaining to the work in this division, and for the correct location of pipe sleeves.
- D. Perform work in accordance with good commercial practice. The good appearance of the finished work shall be of equivalent importance with its operation.
- E. Isolate all conduit, transformers and motors to insure an acceptable noise level free from objectionable vibration for all systems.

3.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Follow the manufacturer's directions in the delivery, storage and handling of equipment and materials.
- B. Equipment and materials shall be tightly covered and protected against dirt, water, chemical or mechanical injury and theft. Damaged equipment will not be accepted.
- C. After materials are installed, protect the installation until the work is completed and accepted by the Owner.

3.5 CLEANING UP

- A. Remove all shipping labels, dirt, paint, grease and stains from all equipment under this division of the Work. Remove debris as it accumulates. Upon completion of the Work, clean all electrical equipment and the entire electrical installation in order to present a first class electrical installation suitable for occupancy. No loose parts, scraps, tools nor debris shall be left on the premises.

3.6 ELECTRICAL SERVICE FOR TESTING

- A. Construct sufficient temporary electric service and connect to refrigeration machines, related pumps, fans, fan coil units, elevators and other equipment furnished under other divisions of the specifications such that the equipment installers may begin testing 30 workdays before job completion deadline.
- B. Notify the electric utility company with sufficient time in advance so they can construct their portion of the permanent electric service entrance to this project. If the electric utility company indicates that permanent service will not be installed when needed, notify the Architect in writing immediately.

3.7 CUTTING AND PATCHING

- A. Be responsible for the cost of cutting and patching required in connection with the work under this division of the specifications.
- B. Coordinate the work to eliminate unnecessary cutting of construction. Where it becomes necessary to cut through walls, floors, ceilings and other construction to permit installation of the work, or to repair defective work under this division, the costs for such cutting and patching shall be included in this division of the work. Comply with other applicable divisions of the specifications concerning the quality of cutting and patching.

- C. Where openings are cut through masonry walls, provide lintels or structural supports to protect the remaining masonry. Provide adequate support during the cutting operation to prevent any damage to the affected masonry.
- D. Cutting of structural members is not permitted unless the Architect grants specific written permission.

3.8 FLASHINGS, SLEEVES, INSERTS

- A. Be responsible for maintaining the integrity of the waterproofing of conduit penetrations through roofs, exterior walls and floors.
- B. Be responsible for the installation of counterflashing of roof penetrations to provide a weatherproof installation.
- C. Install 22 gauge galvanized sheet iron sleeves for each conduit passing through floors. Extend sleeves 1-1/2 in. above the floor slab and cement watertight. The sizes of sleeves shall be installed to permit the subsequent insertion of the proper size conduits or raceways.
- D. Install galvanized wrought iron pipe sleeves around conduits and raceways that pass through concrete beams or walls and masonry exterior walls. The inside diameter of these sleeves shall be at least 1/2 in. greater than the outside diameters of the service pipes. After the pipes are installed in these sleeves, fill the annular space between pipes and sleeves with mastic. The completed installation shall be watertight.
- E. Be responsible for maintaining the fire rating of penetrations through walls, floors and ceilings.
- F. Waterproofing and fireproofing work shall conform to the requirements of other applicable sections of the specifications.

3.9 FOUNDATIONS

- A. Be responsible for the installation of steel reinforced concrete foundations below all floor-mounted switchboards, panelboards, motor control centers, transformers and other floor mounted electrical equipment.
- B. Concrete foundations shall not be less than 4 in. high. All top edges shall be neatly chamfered.
- C. Concrete foundations shall be 3 in. wider and 3 in. longer than the base of the equipment being installed.
- D. All concrete work shall be steel reinforced with a minimum of 6 in. by 6 in., No. 6 mesh and shall conform entirely to the requirements of the other sections of the specifications describing this class of work.

3.10 PAINTING

- A. Maintain original factory finish on all material and equipment installed under this division of the work unless specifically noted otherwise within the Contract Documents. Should the finish be marred in transit or during installation, it shall be re-finished to present a neat, workmanlike appearance. Leave equipment clean and free from any grease, dirt and rust and in a suitable condition for painting.

3.11 IDENTIFICATION OF ELECTRICAL EQUIPMENT

- A. Identify electrical equipment in accordance with the NEC, local authorities and in accordance with the requirements of the Contract Documents.
- B. Use laminated three-ply, engraved plastic nameplates with black surface and white interior core, at least 1/16 in. thick. Engraved lettering shall be condensed gothic at least 1/4 in. high and properly spaced for legible and easy reading. Attach plates to equipment with chromium-plated screws. Adhesive attachment is not acceptable. Identify the following items with engraved nameplates, located as follows:
 - 1. Each switch/fuse unit or circuit breaker in each main panel and each distribution panel - adjacent to switch/fuse unit or circuit breaker.
 - 2. Spares shall be labeled 'Spare'.
 - 3. Each branch circuit panel - on panel trim cover immediately above panel door.
 - 4. Each safety switch, relay cabinet, time clock - on outside of cover. Include the power source on safety switches.
 - 5. Each exhaust fan switch - custom engraved on outside of switch coverplate (high and low if required).
 - 6. Each motor starter - on outside of cover.
 - 7. Each motor starter in motor control center on outside of cover.
 - 8. Outside light switches - custom engraved on outside of switch coverplate.
 - 9. Any switch for load that cannot be seen from the control point - custom engraved on outside of switch coverplate.
 - 10. Engrave coverplates for wiring devices served by emergency power systems with panel designation and circuit number(s) connected to the devices. Fill engraving with indelible black ink.
- C. Custom engraving on cover plates for items noted above shall be equivalent to custom engraving as performed by Hubbell, or accepted substitute.
- D. Install adhesive arc flash warning labels on all equipment as required by the latest NFPA 70E. Each label shall show specific and correct information for specific equipment based on its arc flash calculations. Labels shall show the followings:
 - 1. Nominal system voltage.
 - 2. Equipment/bus name, date prepared, and preparer's name and address.
 - 3. Arc flash boundary.
 - 4. Available arc flash incident energy and the corresponding working distance.
 - 5. Minimum arc rating of clothing.

- 6. Site-specific level of PPE.
- E. Branch circuit panelboard directories shall be completely and properly typewritten, including room numbers. Room numbers and names shall be as finally designated at the jobsite.
- F. Refer to other sections of the specifications for conductor color-coding requirements.

3.12 BALANCING OF PANELS

- A. At the completion of the installation of the electrical system, check each phase of all panels under full load and arrange loads such that all phases carry the proper proportion of load. Submit load readings to Engineer for review as part of project close out documentation.

3.13 LOCKING OF ELECTRICAL FACILITIES

- A. Provide padlocks for exterior electrical facilities subject to unauthorized entry.
- B. Furnish locks to match Owner's locking system. Key all locks alike.
- C. Furnish Owner with two keys per lock up to a quantity of ten keys.
- D. Install locks immediately upon installation of electrical facility.

3.14 ACCESS DOORS

- A. Wherever access is required in walls, ceilings, or soffits to concealed junction boxes, pull boxes or other electrical equipment installed under this division, provide and install access doors as indicated herein.
- B. Furnish and install hinged access door and frame with flush latch handle as follows:
 - 1. Plaster surfaces - Milcor Style K, or accepted substitute.
 - 2. Ceramic tile or drywall surface - Milcor Style M (with 'B' label where required), or accepted substitute.
 - 3. Install panels in locations approved by the Architect and paint as directed.

3.15 RECORD DOCUMENTS

- A. Job set: Promptly following receipt of the Owner's Notice to Proceed, secure from the Architect at no charge to the Contractor, one complete set of all Documents comprising the Contract.
- B. Final Record Documents: At a time nearing the completion of the work, secure from the Architect at no charge to the Contractor one complete set of sepia transparencies of all Drawings in the Contract.
- C. Maintenance of Job Set: Immediately upon receipt of the job set described in paragraph above, identify each of the Documents with the title, "RECORD DOCUMENTS - JOB SET".
- D. Preservation:
 - 1. Considering the Contract completion time, the probable number of occasions upon which the job set must be taken out for the new entries and for examination, and the conditions

under which these activities will be performed, devise a suitable method for protecting the job set to the approval of the Architect.

2. Do not use the job set for any purpose except entry of new data and for review by the Architect, from start of transfer of data to final Project Record Documents.
3. Maintain the job set at the site of Work where the Architect designates that site.

E. Making Entries on Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe the change by graphic line and note as required.
2. Date all entries.
3. Call attention to the entry by a 'cloud' drawn around the area or areas affected.
4. In the event of overlapping changes, use different colors for the overlapping changes.
5. All equipment shall be clearly indicated in its installed location. Exposed items or those easily accessible, as above lay-in ceilings, may be located to scale. Concealed items not readily accessible, such as underground piping, shall be located by dimension.

F. Transfer of Data to Final Project Documents:

1. Approval of recorded data prior to transfer:
 - a. Following receipt of the transparencies described above, and prior to beginning transfer of recorded data thereto, secure the Architect's approval of all recorded data.
 - b. Make required revisions.
2. Transfer of Data to Drawings:
 - a. Carefully transfer change data shown on the job set of Record Drawings to the corresponding transparencies, coordinating the changes as required.
 - b. Clearly indicate at each affected detail and other drawing a full description of changes made during construction, and the actual location of items described above.
 - c. Call attention to each entry by drawing a 'cloud' around the area or areas affected.
 - d. Make changes neatly, consistently, and with the proper media to assure longevity and clear reproduction.

G. Review and Submittal:

1. Submit the completed set of Project Record Documents to the Architect as described above.
2. Participate in review meetings as required.
3. Make required changes and promptly deliver the final Project Record Documents to the Architect.

3.16 OPERATIONS AND MAINTENANCE DATA

- A. Accumulate, as the job progresses, the following data, in duplicate, prepared in a neat brochure or packet folder, and deliver to the Architect for checking and subsequent delivery to the Owner.
 - 1. Manufacturers' warranties, guarantees, service manuals, and operating instructions for equipment and materials covered by this division of the specifications.
 - 2. Copies of approved Shop Drawings.
 - 3. Any and all other data and/or Drawings required during construction.
 - 4. Repair parts list of all major items and equipment including name, address, and telephone number of local supplier and agent.

3.17 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide the services of competent engineers or technicians acceptable to the Architect to instruct representatives of the Owner in the complete and detailed operation of each item of equipment, and each system. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a Letter of Release, acknowledged by the Owner or his Authorized Representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.
- B. Be responsible for proper maintenance of equipment and systems until the instructions have been given to the Owner's personnel and the letter of release acknowledged.
- C. In providing the instructions to the Owner's personnel, follow the written operating and maintenance manuals in all instances, and familiarize the Owner's personnel with such manuals. Operating and maintenance manuals used for instructions shall include wiring diagrams, manufacturers' operation and maintenance manuals, parts lists (with sources identified), and other data as appropriate for each system, and as required elsewhere in the Specifications to be furnished to the Owner prior to final acceptance of the project.

3.18 LOCAL PARTS AND SERVICE

- A. Each item of equipment furnished on this project shall have local representation, factory-authorized service, and an adequate stock of repair parts. "Local" shall be defined, for this purpose, as "within 150 miles of the project site".

3.19 INSTALLATION INSPECTIONS AND CERTIFICATIONS

- A. Obtain timely inspections of the installation by the constituted authorities. Remedy any deficiencies to the satisfaction of the inspection authority.
- B. Upon final completion of the Work, obtain certificates of acceptance from the constituted authorities. Deliver the certificates to the Architect for transmission to the Owner.

3.20 OPERATION PRIOR TO ACCEPTANCE

- A. When any equipment is operable, and it is to the advantage of the Contractor to operate the equipment, he may do so provided that he properly supervises the operation and retains full responsibility for the equipment operated. Regardless of whether or not the equipment has or has not been operated, clean the equipment properly; make required adjustments, and complete punch list items before final acceptance by the Owner.
- B. The date of acceptance by the Architect, for beneficial use by the Owner, shall be the beginning date of the warranty period.

3.21 ACCEPTANCE OF THE WORK

- A. The Work, when completed, will be accepted in a finished, perfect and undamaged state only. Provide for protection of the Work during its progress, and if damaged, do all patching or replacing necessary to its full and satisfactory completion.

3.22 WARRANTY

- A. Furnish a written certificate, guaranteeing all materials, equipment and labor to be free of all defects for a period of one year from the date of final acceptance by the Owner of the Work, and guarantee that if any defects appear within the stipulated guarantee period, such work shall be replaced without charge.
- B. This guarantee shall be extended to include the capacity and integrated performance of all component parts of the various systems.
- C. Lamps for light fixtures shall be excluded from the guarantee requirements of this section.

3.23 FINALLY

- A. It is the intention that this Specification provide a complete installation. Include all accessory construction and apparatus necessary to the operation and testing of the work under this division. The omission of specific reference to any part of the work necessary for such complete installation shall not relieve this Contractor from furnishing and installing such parts.

END OF SECTION

**SECTION 260511
WORK IN EXISTING BUILDING**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
- B. Furnish all labor, materials, services, equipment, and appliances required in conjunction with the work in existing buildings as indicated in the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Use materials to match existing construction unless specified elsewhere in these Contract Documents. Materials shall comply with local codes, be UL listed, and be properly applied for their intended function.

PART 3 - EXECUTION

3.1 EXISTING CONDITIONS

- A. Inspect the jobsite prior to bidding and be familiar with all existing conditions. Include the cost of the work required to accommodate the existing conditions in the bid proposal.
- B. Obtain data related to existing facilities from existing documents, measurements, notations, photographs, surveys and other observations at the site.
- C. Relocate existing items as required to accommodate the new construction. Remove, relocate and reconnect equipment and accessories that are to be reused.
- D. Coordinate the Work with other divisions of the specifications. Determine which items and equipment are to remain, to be relocated or be removed, and perform all work consistent with the Scope of Work.
- E. Loads that exist and are to remain shall be connected to the new distribution system as shown on the Drawings or as required to maintain their proper operation.
- F. Refer to other divisions of the specifications and determine equipment that requires power to be disconnected, or power to be relocated and disconnect power and relocate power to this equipment.
- G. Remove all conductors and exposed conduit rendered unused back to the source of supply.
- H. Perform splices as required to maintain circuit continuity to existing devices or equipment to remain in service.

3.2 DISRUPTION OF EXISTING FUNCTIONS

- A. Access: Access to and use of the existing facilities and site will be restricted, and shall be under the direction and control of the Owner.

- B. Disruptions: Maintain existing electrical, communications, alarm, and other existing systems, and maintain existing functions in service except for scheduled disruptions. Where existing functions to remain in use are disrupted, they shall be fully restored after disruption, in full compliance with this division of the specifications for new work.
- C. Scheduling of Disruptions: Seek and obtain approval two weeks in advance of the event date. Indicate date of event, starting time, and duration of each required disruption.
- D. Notice of Disruption: Date, time and duration of each disruption shall be subject to the Owner's prior approval, and shall include the following information in the form of a memorandum submitted by the Contractor to the Architect for approval by the Owner:

		STARTING		
	FACILITY/SYSTEM	DATE	TIME	DURATION

- E. Emergency Disruptions: When circumstances preclude obtaining advance approval as specified above, make request immediately upon knowledge of the requirement, and perform work so as to cause the minimum amount of disruption, for the minimum duration.
- F. Notification: Notify the Architect and the Owner immediately by telephone and then in writing, as changes and additions to the scheduled disruption requirements become known.
- G. Duration: Complete as large a portion of the work as possible before initiating disruption and perform only that work necessary so as to minimize duration of disruption. Maintain adequate personnel, supplies, materials, equipment, tools, and other resources at job site to avoid unnecessary delay in resumption of normal service.

3.3 SALVAGE, DEMOLITION AND RELOCATION

A. General

1. Modify, remove, or relocate materials and items indicated in the Contract Documents and required by the installation of new facilities.
2. Working jointly with the work under other divisions of the specifications establish and mark salvage and demolition items before commencing work; report items scheduled for relocation, reinstallation or reuse, which are found to be in damaged condition; await further instructions from the Owner's Representative and/or the Architect before commencing with work.
3. Owner shall have first right of refusal for all material and equipment. Deliver salvaged material accepted by the Owner to destinations on the premises as directed and remove material rejected by the Owner from the site.

B. Relocations

1. Make minor relocations necessitated by the conditions at the site or as directed by the Architect, without additional cost to the Owner.
2. Repair and restore to good functional condition equipment, materials and items scheduled for relocation, which are damaged during dismantling or reassembly operations.

3. New materials and items of similar design and quality may be substituted for materials and items indicated to be relocated upon approval of shop drawings, product data, and samples.
 4. Remove carefully, in reverse order to original assembly or placement, items that are to be relocated.
 5. Protect items until relocation is complete.
 6. Clean and repair items to be relocated, and provide new materials, fittings, and appurtenances required to complete the relocations and to restore items to good operating order.
 7. Perform the relocation work in accordance with applicable sections of these specifications, utilizing skilled workers.
- C. Relocating Devices: Remove and reinstall, in locations designated by the Owner's Representative and the Architect, temperature control system devices, relays, wire, conduit, fixtures, equipment and other devices required for the operation of the various systems that are installed in existing-to-be-removed construction.

3.4 EXISTING RACEWAYS

- A. Reuse raceways where possible and where permitted by local codes. Rework raceways to meet code requirements. Secure all raceways that are not properly supported. Paint raceways when exposed to view to match surroundings if existing finish is damaged or soiled.
- B. Fasten existing boxes and raceways securely to provide proper support.

3.5 NEW RACEWAYS

- A. Provide new raceways where required to provide wiring as indicated in the Contract Documents.
- B. Where raceways must be exposed to view, use wiremold, securely fastened, and painted to match surroundings. Provide number of coats of paint as required to cover prime coat of original finish of wiremold.

3.6 EXISTING CEILINGS

- A. Provide a typewritten list of existing damaged ceilings and ceiling tiles. Disregard rooms in which ceilings are to be repaired and replaced. Correlate list to room numbers indicated on drawings.
- B. Mark damaged ceilings and ceiling tiles with easily removable red "stick-on" labels, minimum size two square in.
- C. Submit list prior to commencing work. Do not start work until Architect and Owner review list; otherwise repair and replace damaged ceilings and ceiling tiles.

3.7 EXISTING PANELBOARDS

- A. Service existing panelboards to be reused as follows:
 1. Clean interiors and exteriors.

2. Touch-up damaged finishes with manufacturer's matching touch-up paint.
3. Inspect for component damage and repair or replace as necessary.
4. Tighten conduit and wire terminations.
5. Verify panelboards and panelboard feeders are of adequate capacity for loads to be served as follows:
 - a. Activate loads connected to panelboards to simulate 100 percent demand.
 - b. Measure and record amperage readings of phase and neutral conductors of panelboards feeders.
 - c. Provide typewritten record of recorded measurements to the Engineer for review.
6. Rebalance loads as specified in other sections of the specifications to provide for evenly balanced phases.
7. Provide new typewritten circuit directories.
8. Provide new panelboard identification labels if panelboard designation changes or if no labels exist.

3.8 EXISTING WIRING

- A. Inspect existing wiring to be reused for damage. Repair or replace damaged wiring.
- B. Assure integrity of existing wiring insulation as follows:
 1. Megger wiring phase-to-phase, phase to neutral, phase to ground, and neutral to ground.
 2. Record megger results. Provide typewritten record of results to the Architect for review.
 3. Repair defective insulation to a dielectric value equivalent to that of wire of the same type.
 4. Existing wiring may be replaced with new wiring if, in the Contractor's opinion, costs to the Owner would be lower.
- C. Secure and label existing wiring that is to be disturbed.
- D. Tighten existing wiring terminations and connections.

3.9 EXISTING FOUNDATIONS AND FLOORS

- A. Prior to coring, penetrating or cutting of existing foundations or floors, the Contractor shall notify the Architect in writing and request all as-built and building record drawings showing the location of post tension cables in slabs and subsequent floors. In the event post tension cables do exist in the building, the Contractor shall X-ray the area to be cut, cored or penetrated. Two copies of the X-ray shall be forwarded to the Architect and written approval issued to the Contractor prior to proceeding with the work.
- B. If no as-built or record building drawings are available, then the Contractor shall X-ray the area to be cut, cored or penetrated. Two copies of the X-ray shall be forwarded to the Architect and written approval issued to the Contractor prior to proceeding with the work.

END OF SECTION

**SECTION 260512
MECHANICAL AND ELECTRICAL COORDINATION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Section 26 05 10 - General Requirements for Electrical Work.
- B. Refer to Section 21 00 10 - General Requirements for Fire Protection Work
- C. Refer to Section 22 00 10 - Basic Plumbing Requirements.
- D. Refer to Section 23 00 10 - Basic Mechanical Requirements.

1.2 SUMMARY

- A. This Section describes the coordination between the Fire Protection, Plumbing, Mechanical and Electrical portions of the work.
- B. This Section is included under the Division 21 portion of the Specifications as Section 21 05 12, under the Division 22 portion of the Specifications as Section 22 05 12, under the Division 23 portion of the Specifications as Section 23 05 12, and under the Division 26 portion of the Specifications as Section 26 05 12.

1.3 WORK INCLUDED

- A. Responsibility: Unless otherwise indicated, motors and controls shall be furnished, set in place and wired in accordance with the following schedule. This schedule may include equipment and systems that are not required for this project. Only the equipment and systems that are required on the drawings and/or specified elsewhere will be required by this section:

1.	Equipment Motors	21/22/2 3	21/22/2 3	26
2.	Magnetic Motor Starters			
	a. Automatically controlled, with or without HOA switches	21/22/2 3	26	Notes 1,3,5
	b. Automatically controlled, with or without HOA switches and furnished as part of	21/22/2 3	22/23	Notes 1,3,5

	factory wired equipment			
	c. Manually controlled	21/22/23	26	Notes 1,3,5
	d. Manually controlled and furnished as part of factory wired equipment	21/22/23	26	Notes 1,3,5
	e. Furnished in Motor Control Centers	26	26	Notes 1,3,5
3.	Variable Speed (Frequency) AC Drives	22/23	26	Notes 1,4,5
4.	Line voltage thermostats, time clocks, etc., not connected to control panel systems	23	26	23
5.	Electric thermostats, time clocks, remote bulb thermostats, motorized valves, float controls, etc. which are an integral part or directly attached to ducts, pipes, etc.	22/23	22/23	22/23
6.	Temperature control panels and time switches	23	23	23

	mounted on temperature control panels			
7.	Motorized valves, motorized dampers, solenoid valves, EP and PE switches, etc.	23	23	Note 1
8.	Alarm bells furnished with equipment installed by Division 22 or 23	22/23	22/23	22/23
9.	Wiring to obtain power for control circuits, including circuit breaker	21/22/2 3	21/22/2 3	21/22/2 3
10.	Low voltage controls	21/22/2 3	21/22/2 3	21/22/2 3
11.	Fire protection system (sprinkler) controls	21	21	Note 8
12.	Fire and smoke detectors installed on mechanical units and in ductwork	28	23	Note 8
13.	All relays required for fan shutdown, motorized dampers, smoke	23	23	Note 1

	control devices, and other items integral with HVAC equipment to provide operation and control of HVAC equipment			
14	Smoke dampers, and combination fire/smoke dampers	23	23	Note 7
15	Boiler and water heater controls, boiler burner controls panels	22/23	22/23	22/23
16	Pushbutton stations, pilot lights	22/23	22/23	22/23
17	Heat Tape	21/22/2 3	21/22/2 3	26
18	Disconnect switches, manual operating switches furnished as a part of the equipment	21/22/2 3	21/22/2 3	Notes 1,5
19	Disconnect switches, manual operating switches furnished separate from equipment	26	26	26
20	Multispeed switches	23	23	26
21	Thermal overloads	21/22/2 3	21/22/2 3	21/22/2 3

22	Control relays, transformers	21/22/23	21/22/23	21/22/23				
23	Refrigeration cycle, cooling tower and controls	23	23	23				
24	Tamper switches for fire protection (sprinkler) system	21	21	28				
25	Flow and/or pressure switches for fire protection (sprinkler) system	21	21	28				
26	Fire and jockey pump controllers and automatic transfer switch	21	21	Note 6				
27	Alarm bells or horns for fire protection (sprinkler) system	21	21	28				
28	Generator (underground) fuel tank	22	22	--				
29	Generator fuel level indicator	22	22	26				
30	Generator fuel piping from tank to generator	22	22	--				
31	Underground fuel tank leak detection and	22	22	22	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION

	monitoring system								
NOTES:	(1)	Power wiring as defined in Section 26 29 13 of the specifications shall be provided under Division 26; control wiring as defined in Section 26 29 13 of the specifications shall be provided under Division 21/22/23.							
	(2)	Wiring from alarm contacts to alarm systems provided by Division 26, wiring from auxiliary contacts to air handling system controls provided by Division 23. Division 26 shall provide power to smoke detector. Smoke detectors required for all air handling systems 2000 CFM or greater. Refer to other Division 23 specifications, Division 26 and Drawings for more specific requirements.							
	(3)	For requirements for Magnetic Motor Starters, refer to Section 23 89 65 - MOTOR CONTROLLERS.							
	(4)	For requirements for Variable Speed (Frequency) AC drives, refer to Section 23 89 65 - MOTOR CONTROLLERS.							
	(5)	Disconnect switches, operating switches, starters and other similar items that are factory-mounted, as a part of complete assembly, shall comply with applicable provisions of the National Electric Code. All such disconnect switches shall be fused.							
	(6)	Power wiring from energy source to controllers and automatic transfer switch shall be provided under Division 26. Interconnection power and control wiring from controllers and automatic transfer switch to pumps shall be provided under Division 21, 22 or 23 and conforming to Division 26 specifications. Control wiring from automatic transfer switch to generator starter shall be provided under Division 26.							
	(7)	Division 26 will provide power to all smoke and combination fire/smoke dampers, and Division 28 will provide control for all such dampers using area smoke detectors.							
	(8)	Wiring for sprinkler system controls to be provided by Division 21. Wiring from devices to Fire Alarm System to be provided by Division 28.							

B. CONNECTIONS: Make all connections to controls that are directly attached to ducts, piping and mechanical equipment with flexible connections.

C. PRECEDENCE

1. In general, piping systems that require a stated grade for proper operation shall have precedence over other systems.
2. Precedence for pipe, conduit and duct systems shall be as follows.
 - a. Building lines
 - b. Structural members
 - c. Soil and drain piping
 - d. Vent piping

- e. Steam piping
 - f. Condensate piping
 - g. Refrigerant piping
 - h. Electrical bus duct
 - i. Supply ductwork
 - j. Return ductwork
 - k. Exhaust ductwork
 - l. Chilled water and heating water piping
 - m. Automatic Fire Protection Sprinkler Piping
 - n. Natural gas piping
 - o. Domestic hot and cold water piping
 - p. Electrical conduit
3. Lighting Fixtures shall have precedence over air grilles and diffusers.

D. FINAL INSPECTION AND REPORT

1. At the completion of the work, there shall be a meeting of the Fire Protection, Plumbing, Mechanical, Electrical Fire Alarm and Temperature Control Contractors, representatives of mechanical and electrical equipment manufactures whose equipment was actually installed on the project, and similarly-involved individuals, who shall thoroughly inspect all systems, and who shall mutually agree that all equipment has been properly wired and installed, and that all temperature and safety controls are properly functioning. A written report of this meeting, listing those in attendance, and the companies that they represent, shall be filed with the Owner and Architect or Engineer.

END OF SECTION

**SECTION 260519
WIRES AND CABLES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
- B. Provide labor, materials, services, equipment and appliances required in conjunction with the installation of wire and cable systems as indicated in the Contract Documents.

1.2 SUBMITTALS

- A. Manufacturer's Data: Submit copies of manufacturer's specifications for products to be used.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide conductors made of soft-drawn-annealed copper with conductivity not less than that of 98 percent pure copper. Conductors #12 gauge and smaller shall be solid. Conductors No. 10 gauge and larger shall be stranded.
- B. Utilize conductors with insulation rated at 600 volts and insulated with type 'THHN' insulation in dry locations and type "THWN" in wet locations for conductors #1 gauge and smaller. Utilize conductors with insulation rated at 600 volts and insulated with type 'XHHW' insulation for conductors #1/0 gauge and larger. Wire in fixture channels and other special locations shall be as specifically rated for temperature in Article 300 in the NEC.
- C. Minimum wire sizes shall be in accordance with other requirements of the specifications and as follows: For 20 ampere branch circuits #12 gauge, except that home runs greater than 50 ft. from the panel to the first outlet box on 120/208 volt shall be #10 gauge. Where home runs are greater than 100 ft. from the panel to the first outlet box, on 277-volt circuits wire shall be #10 gauge.
- D. All wire shall be color-coded. Mark conductors on each end with a 1 in. band of colored pressure-sensitive plastic tape or by the use of brilliant waterproof lacquer, applied according to manufacturer's instructions. Colors for each phase and the neutral shall be consistent throughout the system in accordance with the requirements of this section.
- E. Conductor sizes shown on the Contract Documents are selected based upon use with 75 degrees C terminations. Furnish terminations, which are UL listed for 75°C, or derate conductors for use at 60°C. Use of 90°C terminations is acceptable, but conductor must be sized at the 75°C rating. Do not use 90°C rating for conductors.
- F. Armored cable types AC and BX are specifically not allowed.
- G. Armored cable type MC is specifically not allowed.

PART 3 - EXECUTION

3.1 GENERAL WIRING METHODS

- A. Place an equivalent number of conductors for each phase, neutral and ground of a circuit in same raceway or cable.
- B. Do not share neutral conductors between branch circuits connected to single pole circuit breakers unless shown otherwise on drawings.
- C. Splice only in junction or outlet boxes.
- D. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- E. Make conductor lengths equal for parallel circuits.
- F. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling #4 gauge and larger wires.
- G. When inserting conductors in raceways, comply with the following:
 - 1. Raceways shall first be installed as a complete raceway system without conductors.
 - 2. Do not install pull wires and conductors until the raceway system is in place.
 - 3. Do not use cleaning agents and lubricants that have a deleterious effect on the conductors.
 - 4. Completely and thoroughly swab raceway system before installing conductors.

3.2 PHASING

- A. Identify wire and cable for feeders and branch circuits for general power and lighting with a visible color code in accordance with the requirements of this section as follows:

	<u>120/208 Volt</u>	<u>277/480 Volt</u>
	Phase A - Black	Phase A - Brown
	Phase B - Red	Phase B - Orange
	Phase C - Blue	Phase C - Yellow
	Neutral - White	Neutral - Gray
	Ground - Green	

- B. Provide green or bare grounding conductor identification for grounding conductors. Identification of all ungrounded conductors at junction boxes, wireways, and/or terminations may be by means of colored tape or painting when color-coded conductors as specified above are not available.
- C. Phasing of the complete electrical installation shall be connected and maintained the same throughout the power distribution system. Where the project is an addition or modification to an existing facility, the electrical distribution system phasing shall be made the same as the existing.
- D. Switchgear, safety switches, motor starters, plug-in type bus duct, lighting and power panels and power receptacles shall have all the same phase arrangements throughout the facility.

3.3 INSTALLATION

- A. Install conductors in a neat and workmanlike manner to meet code requirements and make runs continuous without weld, splice, or joint between boxes. Do not install wires in conduit unless the entire system of conduit and outlet boxes is permanently in place. Pull conductors using a UL approved wire lubricant.
- B. Provide conductors continuous from outlet to outlet with no splices except at outlets. Leave sufficient wire at all outlets to make connections without straining.
- C. Deliver cable and wire to the project in original packages. Conductors with insulation showing deterioration within one year after final completion and acceptance of the Work shall be removed and replaced at no cost to Owner.
- D. Thoroughly clean wires before installing lugs and connectors.
- E. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- F. Terminate spare conductors with electrical tape.
- G. Torque test conductor connections and terminations to manufacturer's recommended values.
- H. Where outlets only are indicated, leave 48-in. leads of conductors, for connection to equipment. Identify all conductors' circuit numbers with Brady tape at terminals and junctions.
- I. Where more than three current-carrying conductors are installed in a raceway, use larger size conductor and appropriate larger size raceway to comply with Article 310 of the National Electrical Code.
- J. Where conductor is installed in an environment where the ambient temperature will exceed 86°F, use larger size conductor and appropriate larger size raceway to comply with Article 310 of the National Electrical Code.
- K. Test all circuits for grounds. Light and test each lamp. Prove and test energy available at the load side of disconnect switches and at the final point of connection to driven equipment. Make all necessary and reasonable tests as required by the Architect to prove the integrity of work and leave the complete electrical installation ready for operation.

END OF SECTION

**SECTION 260520
WIRE CONNECTION AND DEVICES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
- B. Provide labor, materials, services, equipment and appliances required in conjunction with the installation of wire connections and devices systems as indicated in the Contract Documents.

1.2 SUBMITTALS

- A. Manufacturer's Data: Submit copies of manufacturer's specifications for products to be used.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Make cable and wire connections for splicing or terminating with compression deforming type connectors as manufactured by Burndy Corp., Thomas & Betts Co., Inc., Dossert Manufacturing Corp., IlSCO Corp., or accepted substitute. Connectors for cable sizes 250 Kcmil and larger shall be the long barrel type for double indentation. Soldered connections will not be permitted. Twist-on insulated connectors, of proper size, and resistant to vibration, may be used. Use twist-on connectors as manufactured by Minnesota Mining and Manufacturing Co., Thomas & Betts Co., Inc., Ideal Industries, Inc., or approved equivalent.
- B. Provide terminal connectors with the hole sizes and spacing in accordance with NEMA standards. Provide terminal connectors with two holes in tongue for use on conductor sizes 250 Kcmil and larger. Terminal connectors are not required for connections to the circuit breakers in the lighting and/or receptacle panels.
- C. Insulate connections made with non-insulated connectors with three layers of plastic tape, each layer being half-lapped. Use No. 35+ plastic tape as manufactured by Minnesota Mining and Manufacturing Co., or similar and equivalent plastic tape as manufactured by Plymouth Rubber Co.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Make all electrical power and control connections to equipment furnished under other divisions of the specifications and furnish wiring, conduit, outlet boxes, disconnect switches, etc., as required for same. Check General Construction, Controls, Plumbing, Heating, and Air Conditioning, etc. plans and specifications to determine the amount of such wiring required and include cost of same in bid. Verify locations, horsepower, voltages, etc., of all equipment as the job progresses. If a conflict arises in wiring, ask the Engineer immediately for clarification.
- B. Provide branch circuits and connections to all motors furnished to this project. Provide all disconnect switches as shown and where required by national or local codes. In general, all wiring shall be in conduit, with a short section of flexible conduit at each motor. Securely attach conduit to flexible conduit. When the motor is an integral part of equipment, isolate with a short section of flexible metal conduit to prevent vibration and/or noise amplification to the building

structure. If the motor is adjustable, an additional length of flexible metal conduit shall be installed at the motor. Connect a ground wire from the conduit termination to the motor frame on the inside of the flexible conduit. Use approved grounding lugs or clamps on the conduit connection.

- C. Branch circuits and connections to all electrically operated equipment are included in this contract, whether or not specifically mentioned. Check, on the job, for further details on Plumbing, Heating, and Air Conditioning equipment as project progresses. Ground equipment in an approved manner.
- D. Major equipment furnished under the mechanical and other sections of the specifications may require different rough-in requirements than indicated on the plans due to the 'or equivalent' equipment clause. Secure detailed drawings from the trade furnishing the equipment to determine actual rough-in locations, conduit and conductor requirements.
- E. Before connecting equipment, check the nameplate data against the information shown on the Drawings. Call any discrepancies to the attention of the Architect.

END OF SECTION

**SECTION 260526
GROUNDING**

PART 1 - GENERAL

1.1 SUMMARY

- A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
- B. Furnish all labor, materials, services, equipment and appliances required in conjunction with the installation of a grounding system as indicated in the Contract Documents.

1.2 SUBMITTALS

- A. Manufacturer's Data: Submit copies of manufacturer's specifications for products used.

1.3 TESTS

- A. Measure ground grid resistance with earth test megger and install additional ground rods and conductors as required until resistance to ground complies with Code requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide a grounding system that includes all connections and testing of ground rods, ground cables, ground buses, conduits, fittings, anchors, supports, thermite process materials and equipment, and other materials as required for a complete installation.
- B. Provide ground cables composed of stranded bare copper of 98 percent conductivity encased in conduits above grade, or buried to a depth not less than 12 in. below grade. Install as required to provide sufficient mechanical protection.
- C. Provide Thomas & Betts Co., Inc., Catalog No. 3951, or approved equivalent, ground fittings for bonding ground cable to its encasing conduit.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Ground electrical work in accordance with NEC Article 250, local codes as specified herein, and as shown on the Drawings.
- B. Install ground cables continuous between connections. Splices will not be allowed except where indicated on the Drawings. Where ground cables pass through floor slabs, building walls, etc., and are not in metallic enclosures, provide with sleeves of approved nonmetallic material.
- C. Install grounding conductor in all raceways and under floor ducts.
- D. Ground interior lighting fixtures with grounding conductor to rigid metal raceways serving them. Flexible metal conduit in lengths less than 6 ft. 0 in. may be used as grounding conductors when terminated with approved fittings on circuits of 20 amperes or less.

- E. Where connections are made to motors or equipment with flexible metal conduit, grounding conductor shall be stranded copper conductor within the conduit, bonded to the equipment and to the rigid metal raceway system. Size conductor in accordance with NEC, Article 250.
- F. At each convenience outlet, install a grounding clip attached to the outlet box and leave a sufficient length of No. 12 wire with green colored insulation to connect to the grounding terminal of the receptacle. Grounding clip shall be equivalent to Steel City Type G. This requirement may be deleted if automatic grounding clip receptacle meeting NEC Article 250.

3.2 COMMUNICATION GROUNDING

A. Telephone:

- 1. Provide one No. 4 THW to main service ground bus from each telephone equipment room. Leave 12 in. pigtail at telephone board.

B. Fire Alarm and Detection:

- 1. Provide one No. 6 THW in 1/2 in. conduit to nearest ground bus.

C. Television Distribution System:

- 1. Provide one No. 6 THW in 1/2 in. conduit to nearest ground bus.

D. Public Address System:

- 1. Provide one No. 6 THW in 1/2 in. conduit to nearest ground bus.

3.3 COORDINATION

- A. Coordinate the work under this section with the work under other divisions of the specifications.

END OF SECTION

**SECTION 260527
SEALING OF PENETRATIONS**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
- B. Provide labor, materials, services, equipment and appliances required in conjunction with sealing of penetrations as indicated in the Contract Documents.

1.2 SUBMITTALS

- A. Samples: Provide samples upon written request.
- B. Product Data: Manufacturer's specifications and installation instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Acceptable Manufacturers:
 - 1. Caulk and Putty: 3M's No. CP-25 and No. CP-303 synthetic elastomers.
 - 2. Wrap/Strip: 3M's No. FS-195 organic/inorganic, fire resistive sheet with aluminum foil on one side.
 - 3. Composite Sheet: 3M's No. CS-195 organic/inorganic fire resistive elastomeric sheet, bonded on one side with 28-gauge galvanized steel and the other side with reinforced hexagonal shaped steel wire mesh and covered with aluminum foil.
 - 4. Thunderline Model "LS/Link-Seal" seals, of the required size and number of links, shall be used on all conduit penetrations of exterior walls. Similar fittings by O.Z./Gedney shall be considered approved equivalents.

2.2 ROOF PENETRATION SYSTEMS

- A. General: Construct roof penetration systems utilizing the "Alumi-Flash" system by Portals Plus, Inc., or equal by Thy-Curb.
- B. Each roof penetration shall include a spun aluminum base ("High" size if required due to the existing roof construction and any insulation thickness) and an EPDM rubber cap. Each rubber cap shall have a pre-molded pipe opening and shall be selected based on the actual pipe or conduit size required at each location. Secure each rubber cap to each pipe or conduit with the manufacturer's recommended stainless steel gear clamp.
- C. Manufacturer: Subject to compliance with requirements, provide roof penetration systems of one of the following:
 - 1. Portals Plus, Inc.
 - 2. Thycurb Div.; Thybar Corp.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Review the detailed requirements of the UL through penetration fire stop assembly to be used and verify dimensional requirements such as maximum conduit size, conduit spacing, maximum opening size, minimum length of sleeve, etc.
- B. For sealing of sleeves on or below grade and in wet locations, install link seals around all conduit penetrations properly sealing the annular space between the sleeve and the conduit to provide a waterproof seal.
- C. For sealing of sleeves above grade and in dry/damp locations, use specified fire stop material and install per manufacturer's instructions and in conformance with UL requirements.
- D. Attach an adhesive warning label identifying the fire stop assembly and warning against removal without proper resealing.
- E. Seal floor, wall and ceiling penetrations or fire rated assemblies in above grade and in dry/damp locations, both horizontal and vertical, utilizing intumescent (expand when heated) materials designed to be applied as a fire, cold smoke, noxious gas, and water sealant. Penetrations shall meet the requirements of ANSI/UL 1479 "Fire Tests of Through-Penetration Firestops".

END OF SECTION

**SECTION 260529
SUPPORTING DEVICES**

PART 1 - GENERAL

1.1 SUMMARY

- A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
- B. Furnish all labor, materials, services, equipment and appliances required in conjunction with installation of supporting devices as indicated in the Contract Documents.

1.2 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's engineering brochures.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Kindorf
- B. Unistrut
- C. Superstrut
- D. Powerstrut

2.2 MATERIALS

- A. Continuous slotted channel: 12 gauge steel with electro-galvanizing and gold zinc dichromate barrier bases and dimensions as required for application.
- B. Hanger rods: Continuous thread, electro-galvanized, steel, with gold zinc dichromate barrier, sizes as required for loads imposed.
- C. Hex head cap screws and nuts: No. H-113 and No. 114, respectively.
- D. One-hole pipe straps: Series HS-100, galvanized steel.
- E. Single bolt channel pipe straps: Steel, with machine screw and nut, Series C-105 and Series C-106.
- F. Lay-in pipe hanger: Series C-149.
- G. Conduit and pipe hanger: Series 6H.
- H. Beam clamps: Series 500, RC, EC and PC as applicable.
- I. Concrete inserts, spot: Series D-256 or D-255.
- J. Concrete inserts, channel: Series D-980 or Series D-986.
- K. Riser clamps: Series C-210.

- L. Cable supports: O.Z./Gedney Type S.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Carefully lay out supporting devices to coordinate with the work under other divisions of the specifications.
- B. Securely fasten and support conduits and raceways to the building structure.
- C. Suspend horizontal runs of conduits and raceways from the floor and roof construction by rod hangers spaced 10 ft. or less on centers for sizes 2-1/2 in. and greater, and 9 ft. or less on centers for 2 in. and smaller.
- D. Fasten single runs of conduit to the structure with one-hole pipe straps and beam clamps or hang on rod hangers.
- E. Support multiple runs of conduit and raceways from continuous channel inserts or from trapeze hangers constructed of rod hangers and channels.
- F. Fasten single conduits to rod hangers with adjustable lay-in pipe hangers or for conduits of sizes 2 in. and smaller with Series 6H pipe hangers.
- G. Fasten conduits to channels with pipe channel straps.
- H. Support conduits and raceways within 3 ft. of each bend, of each termination, and at other intervals to maintain horizontal and vertical alignment without sag and deformation.
- I. Do not use cable, strap, or wire hangers and fasteners.
- J. Provide riser clamps for conduits at floor lines. Provide wire and cable supports in pull boxes for risers in accordance with NEC.
- K. Install supports to permit equivalently distributed expansion and contraction of conduits and raceways with expansion joints. Use guides consisting of saddles, U-bolts and anchors designed for equivalent effectiveness for both longitudinal and transverse thrusts. Submit complete details for review.
- L. Do not support conduits and raceways from equipment connections.
- M. Provide special supports with vibration dampers to minimize transmission of vibrations and noises, where required.
- N. Provide hangers, racks, cable cleats, and supports for wires and cables in cable chambers and other locations to make a neat and substantial installation.
- O. Provide steel angle and channel supports to the floor and structure for panelboards, cabinets, pull and junction boxes. Provide independent support from entering conduits and raceways.
- P. Provide supports as specified for conduits and raceways for outlet boxes and pull boxes 100 cubic in. and smaller.
- Q. Paint all cuts, breaks, welds and other points where the rust inhibiting coating of supports is damaged.

- R. Provide supports sized for the ultimate loads to be imposed.
- S. Anchor supporting devices with:
 - 1. Wood screws on wood.
 - 2. Toggle bolts on hollow masonry.
 - 3. Bolts and expansion anchors in concrete or brick.
 - 4. Machine screws, threaded rods and clamps on steel.
- T. Provide supports with hot-dipped galvanized finish in outdoor and wet locations.
- U. Pipe and conduit supports:
 - 1. Single run pipe and conduits, 2-1/2 in. O.D. and less, shall have Type SS-8R/SS-8C as manufactured by Portable Pipe Hangers, Inc., or approved equivalent, spaced at maximum eight ft. on center and installed on roof pads if required by the roofing manufacturer.
 - 2. Multiple run pipe and conduits larger than 2-1/2 in. O.D. shall have Type PS, PSE, PP-10 with Roller, or PP-10 with Bar, as manufactured by Portable Pipe Hangers, Inc., or approved equivalent, spaced at maximum eight ft. on center and installed on roof pads if required by the roofing manufacturer. All conduits shall be held in place with clips on bars.

END OF SECTION

**SECTION 260532
PULL AND JUNCTION BOXES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
- B. Provide labor, materials, services, equipment and appliances required in conjunction with the installation of pull and junction boxes as indicated in the Contract Documents.

1.2 SUBMITTALS

- A. Manufacturer's Data: Submit copies of manufacturer's specifications for products to be used.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pull boxes and junction boxes used on concealed runs of conduit in walls and over ceilings shall be of code gauge galvanized steel with sheet steel covers. Pull boxes in floors shall be of galvanized malleable cast iron, with gasketed covers. Exposed pull boxes or junction boxes installed outdoors shall be weatherproof and shall be provided with watertight gasketed covers fastened with corrosion resistant screws.
- B. Pull Boxes and Junction Boxes: Metal construction conforming to National Electrical Code, with screw-on or hinged cover. Use hinged cover for boxes larger than 12 in. in any dimension.
- C. Flush-Mounted Pull Boxes: Provide overlapping covers with flush-head cover retaining screws, prime coated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Use separate pull boxes and junction boxes for electric power, control, lighting, computer and communication systems.
- B. Install pull boxes and junction boxes where required by the National Electrical Code and wherever required to overcome mechanical difficulties.
- C. Install pull boxes in interior conduit at not more than 100 ft. apart when junction or outlet boxes do not break conduit runs.
- D. Size pull boxes and junction boxes to best meet the needs of the particular situation and/or location and to comply with the National Electrical Code.
- E. Coordinate the work in this section with the work under other divisions of this specification.

END OF SECTION

SECTION 260533 CONDUITS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
- B. Provide labor, materials, services, equipment, and appliances required in conjunction with the installation of conduit systems as indicated in the Contract Documents.

1.2 SUBMITTALS

- A. Manufacturer's Data: Submit copies of manufacturer's specifications and product data for products to be used.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Rigid Metal Conduit: Heavy-wall, mild steel tube with metallic corrosion-resistant coating on interior and exterior, hot-dipped galvanized, free from defects and manufactured in accordance with ANSI standards, and UL listed.
- B. Electric Metallic Tubing (EMT): Welded steel tubing formed of low carbon steel, electro-galvanized exterior, inside coated with a thick, baked, tough elastic low-friction coating of enamel, and UL approved.
- C. Intermediate Metal Conduit (IMC): Manufactured in accordance with UL 1242 with interior coating of silicone epoxy ester lubricant.
- D. Flexible Metal Conduit: Single strip helically wound interlocking galvanized steel, UL listed; provide liquid tight with extruded polyvinyl jacket in damp and wet locations and in kitchens.
- E. Elbows and Bends:
 - 1. Same material as the conduit with which they are installed.
- F. Bushings:
 - 1. 1-1/4 in. and smaller - high-impact thermosetting phenolic insulation, 150°C, O-Z/Gedney Type A.
 - 2. 1-1/2 in. and larger - hot-dipped galvanized with thermosetting phenolic insulation, 150°C, O-Z/Gedney Type B.
- G. Locknuts:
 - 1. 1-1/4 in. and smaller - zinc-plated heavy stock steel, O-Z/Gedney.
 - 2. 1-1/2 in. and larger - cadmium-plated malleable iron, O-Z/Gedney.
- H. Hubs: Cadmium-plated malleable iron, tapered threads, neoprene 'O' ring, insulated throat, O-Z/Gedney.

- I. EMT Connectors: Compression type, zinc-plated steel body, cadmium-plated malleable iron nut, insulated throat, O-Z/Gedney.
- J. EMT Couplings: Compression type, zinc-plated steel body, O-Z/Gedney.
- K. Liquid tight Conduit Connectors: Cadmium-plated malleable iron body and nut, cadmium plated steel ferrule, insulated throat, integrally-cast external ground lug, O-Z/Gedney Type 4QL.
- L. Through-Wall and Floor Seals: Malleable iron body, oversize sleeves, sealing rings, pressure clamps and hex-head cap screws, O-Z/Gedney Type FSK.
- M. End Bells: Hot-dipped galvanized, threaded, malleable iron, O-Z/Gedney Type TNS.
- N. Expansion Fittings: Hot-dipped galvanized, malleable iron with bonding jumpers.
 - 1. Linear - O-Z/Gedney Type AX or TX.
 - 2. Linear with deflection - O-Z/Gedney Type AXDX.
- O. Escutcheons: Chrome-plated sectional floor and ceiling plates, Crane No. 10.
- P. Accessories: Reducers, bushings, washers, etc., shall be cadmium-plated, malleable iron of the forms and dimensions best suited for the application.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Size conduits as indicated on the Contract Drawings and as required by the National Electrical Code for the quantity and sizes of wires to be installed in the conduit. Do not use conduit sized less than 3/4 in. unless specified otherwise.
- B. No more than one, three-phase circuit or three, single phase circuits may be placed in a single conduit, unless specifically noted on the drawings as such.
- C. Conceal conduits from view in all areas except mechanical and electrical rooms and crawl spaces. Should it appear necessary to expose any conduit:
 - 1. Bring it to the attention of the Architect immediately and obtain Architect's approval for location of exposed conduit.
 - 2. Rearrange the work to facilitate an approved installation.
- D. Install conduits at elevations to maintain headroom and at locations to avoid interference with other work requiring grading of piping, the structure, finished ceiling, walls, access panels, etc. Avoid crossing other work.
- E. To prevent displacement, securely support conduits to be concealed in the building structure and installed in advance of other work. Carefully lay out conduits installed within the structure, such as floors, beams, and walls to avoid densities excessive for the construction.
- F. Ream, remove burrs, and swab inside conduits before pulling in conductors.
- G. Cap or plug conduits with standard manufactured accessories as soon as the conduits have been permanently installed in place.

- H. Make bends and offsets in 1 in. and smaller conduits with approved bending devices. Do not install conduits, which have had their walls crushed, deformed or their surface finish damaged due to bending.
- I. Where space conditions prohibit the use of standard ells, elbows, and conduits, use cast ferrous alloy fittings of such forms and dimensions as best suited for the application.
- J. Make conduit joints mechanically tight, electrically continuous, and watertight. Pitch conduits in areas where moisture may subsequently be present in a manner to avoid creating moisture traps; where unavoidable, provide junction box with drain fitting at conduit low point.
- K. Install insulated throat threaded hubs on conduits entering enclosures without threaded hubs in wet and damp locations.
- L. Install and neatly rack exposed conduits parallel with and perpendicular to building walls. Provide space for 25% additional conduit. Do not install exposed diagonal conduit runs.
- M. Route and suspend conduits crossing expansion joints to permit expansion, contraction, and deflection utilizing approved fittings to prevent damage to the building, conduits, and supporting devices.
- N. Do not install conduits exposed on the roof unless approval is obtained prior to installation.
- O. Route conduit through roof openings for piping and duct-work where possible; otherwise, route through roof penetration system as specified in Section 260527 - SEALING OF PENETRATIONS.
- P. Do not place conduits in close proximity to equipment, systems and service lines, such as hot water supply and return lines, steam pipes, which could be detrimental to the conduit and its contents. Maintain a minimum of 3 in. separation, except in crossing, which shall be a minimum 1 in.
- Q. Connect motors, equipment containing motors, equipment mounted on isolated foundations, transformers and other equipment and devices which are subject to vibration and which require adjustment, with flexible metallic conduit from the device to the conduit serving it. Restrict length of flexible conduit to 6 ft. maximum unless specifically instructed in writing otherwise by the Architect. Provide secure supports at the points of attachment on each side of the connection. Use bonding jumpers as directed by the National Electrical Code and other sections of these specifications.
- R. Install escutcheons on sight exposed conduits passing through interior floors, walls, and ceilings in finished spaces
- S. Install fire seals on conduits passing through fire-rated partitions, floors and ceiling.
- T. Install through-wall seals on conduits passing through exterior walls or use standard galvanized steel pipe sleeves, diameters 1/2 in. greater than the outside diameter of the sleeved conduit and fill the annular space with mastic.
- U. Install sleeves for conduits passing through interior floors.
- V. Install insulated throat grounding bushings on conduits stubbed through slabs and foundations into electrical enclosures.

W. Provide grounding of conduits, fittings and accessories. Refer to grounding section of specifications.

X. Feeder Circuits:

1. Install rigid metal conduit in damp and wet locations and where exposed in mechanical and electrical equipment rooms and crawl spaces.
2. Install flexible metal conduit where specified above and where permitted by the authorities having jurisdiction. Use liquid tight flexible metal conduit in damp and wet locations, and where exposed in mechanical and electrical equipment rooms.

Y. Branch Circuits:

1. Install rigid metal conduit in damp and wet locations and where exposed in crawl space.
2. Install electrical metallic tubing where concealed by building structure and where exposed in mechanical and electrical equipment rooms.
3. Install flexible metal conduit where specified above and where permitted by the authorities having jurisdiction. Use liquid tight flexible metal conduit in damp and wet locations, where exposed in mechanical and electrical equipment rooms, and in kitchen and shop areas. Limit flexible conduit to a length of 6 ft. maximum unless specifically instructed otherwise, in writing, by the Architect.

END OF SECTION

**SECTION 260534
OUTLET BOXES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
- B. Provide labor, materials, services, equipment and appliances required in conjunction with the installation of outlet boxes as indicated in the Contract Documents.

1.2 SUBMITTALS

- A. Manufacturer's Data: Submit copies of manufacturer's specifications for products to be used.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, with 1/2 in. male fixture studs where required.
- B. Cast Boxes: Cast metal, deep type, gasketed cover, threaded hubs. Use cast boxes for damp and outdoor installation.
- C. Provide boxes with plaster ring where required. Boxes for installation in masonry walls shall be special square corner masonry type.
- D. Furnish boxes with proper covers and device plates.
- E. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as rain tight. Cast metal box and cover with ground flange, neoprene gasket, and stainless steel cover screws.

2.2 FLOOR BOXES

- A. Single Service (Power, data, telephone, etc.)
 - 1. Ground level and below: round, cast iron, fully adjustable, Hubbell #B2537 with brass cover and threaded outlets #S3725 for flush outlets and #SC3099/98 series pedestal for surface receptacles. Use #SC309D for single duplex receptacle and #SC309B for back or blank face. Use SB3182 brass carpet flange in areas that have carpet.
 - 2. Above ground level: round, galvanized steel, fully adjustable, Hubbell #B2529 with covers and fittings as described in 2.2.A.1 above.
 - 3. Ground level and below; telephone and other communication outlets: round, cast iron, fully adjustable, Hubbell #B2536 with brass cover and threaded outlet #S2525 cover for flush outlet and #SC3099/98 series pedestal and SS309T for telephone single outlet. Use #SB3182 brass carpet flange in areas that have carpet.
 - 4. Above ground level; telephone and other communication outlets: round, galvanized steel, fully adjustable, Hubbell #B2529 with covers and fittings described in 2.2.A.3 above.

B. Multiple Service (Power, data, telephone, etc.)

1. Rectangular, cast iron, fully adjustable with number of gangs as shown on plans, Hubbell #B4000 series with brass cover and threaded outlets #S3625. Use SB308X series brass carpet flange in areas that have carpet.

PART 3 - EXECUTION

3.1 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on the Drawings, and as required for splices, taps, wire pulling, equipment connections and code compliance.
- B. Determine from dimensions shown on the Contract Documents and by actual measurements on the site, the exact location of each outlet. Outlet locations shall be modified from those shown on the plans to accommodate changes in door swings, space changes or to clear other interferences that arise or from job modifications. Make such modifications at no cost to the Owner as a matter of job coordination. Coordinate job conditions and notify the Architect of discrepancies before proceeding with the installation of the work. Set wall boxes in advance of wall construction blocked in place, and secure. Set wall boxes flush with the finish. Install extension sleeves as required to extend boxes to finished surfaces.
- C. The locations of equipment and outlets shown on the Contract Documents are approximate. Check and verify exact locations in the field. Coordinate installation with the Architect and with the work under other divisions of the specifications.
- D. Unless otherwise noted, location of outlet boxes, measured to centerline of box, shall be as follows:

EQUIPMENT OR OUTLETS	ELEVATION (ABOVE FINISHED FLOOR)
Toggle Switches	3 feet - 10 inches
Fire Alarm Pull Stations	3 feet - 10 inches
Receptacles	1 foot - 6 inches
Clock and Clock Outlets	7 feet - 6 inches
Fire Alarm Audible or Audible/Visual Devices	6 feet - 8 inches to bottom of device
Combination motor starters	5 feet - 0 inches
Control stations	3 feet - 10 inches
Manual starters	5 feet - 0 inches
Thermostats in office	3 feet - 10 inches
Telephone/data outlets	1 foot - 6 inches
Circuit protective devices	6 feet - 6 inches to top of enclosure

- E. Locate and install boxes to allow access. Where installation is inaccessible, coordinate locations and sizes of required access doors in accordance with other sections of the specifications.
- F. Locate and install to maintain headroom and to present a neat appearance.

3.2 OUTLET BOX INSTALLATION

- A. Do not install boxes back-to-back in walls. Provide a minimum 6 in. separation in common wall cavity, except provide minimum 24 in. separation in acoustic rated walls. Refer to architectural drawings for locations of acoustic walls.
- B. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.
- C. Provide knockout closures for unused openings.
- D. Use multiple-gang boxes where multiple devices are shown to be installed together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- E. Install boxes in walls without damaging wall insulation.
- F. Coordinate mounting heights and locations of outlets mounted above counters, benches and back splashes.
- G. Position outlets to coordinate luminaire locations with ceilings.
- H. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.
- I. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- J. Align wall-mounted outlet boxes for switches, thermostats and similar devices.

END OF SECTION

**SECTION 260535
WIREWAY**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
- B. Provide labor, materials, services, equipment and appliances required in conjunction with the installation of wireway systems as indicated in the Contract Requirements.

1.2 SUBMITTALS

- A. Submit copies of manufacturer's specifications for products used.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide wireway as manufactured by Square D, Hoffman, B-Line or accepted substitute.
- B. General-purpose wireway: Square D Square Duct Series LD.
- C. Wireway end closures, supports and associated fittings: Square D, of best forms and dimensions for applications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide systems of wireway of sufficient size where indicated. Provide for equipment racks or cabinets mounted in close proximity.
- B. Size wireway cross-sectional area and length based upon conductor fill and equipment served as required by the NEC and local codes.
- C. Install types based on environmental conditions to which exposed.
- D. Coordinate the work in this section with the work under other divisions of this specification.

END OF SECTION

**SECTION 262716
CABINETS**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
- B. Provide labor, materials, services, equipment and appliances required in conjunction with the installation of cabinets as indicated in the Contract Documents.

1.2 SUBMITTALS

- A. Manufacturer's Data: Submit copies of manufacturer's specifications for products to be used.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Interior: Provide galvanized code gauge steel cabinets with over-lapped-welded corners with front edges turned over to receive trim. Provide adjustable trim fastened to the cabinets with captive hardware, continuous hinge doors, and a circuit directory on inside of door. The door shall have cylinder tumbler type lock. Provide combination three-point catch and lock for doors more than 48 in. high.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide cabinets for flush or surface mounting for all lighting panels, power panels and elsewhere as indicated.
- B. Verify wall thickness prior to installation of flush-mounted cabinets to determine adequate space for cabinet to be flush mounted. If wall is not deep enough to install cabinet flush with wall, consult Architect for direction.
- C. Install three one-inch empty conduits from each flush-mounted cabinet to nearest accessible ceiling space for future use. Turn conduits horizontal at accessible ceiling space.
- D. Coordinate the work under this section with the work of other divisions of this specification.

END OF SECTION

**SECTION 262726
WIRING DEVICES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
- B. Provide labor, materials, services, equipment and appliances required in conjunction with the installation of wiring devices as indicated in the Contract Documents.

1.2 SUBMITTALS

- A. Manufacturer's Data: Submit copies of manufacturer's specifications for products to be used. Manufacturer's catalog numbers listed are used to set the standard.
- B. Acceptable Manufacturers: Hubbell, Leviton and Pass & Seymour. All wiring devices for the project shall be of one manufacturer.

PART 2 - PRODUCTS

2.1 SWITCHES

- A. Single pole, 20 amp
 - 1. Hubbell HBL1221; Leviton 1221-2; Pass & Seymour PS20AC1
- B. Double pole, 20 amp
 - 1. Hubbell HBL1222; Leviton 1222-2; Pass & Seymour PS20AC2
- C. Three way, 20 amp
 - 1. Hubbell HBL1223; Leviton 1223-2; Pass & Seymour PS20AC3
- D. Four way, 20 amp
 - 1. Hubbell HBL1224; Leviton 1224-2; Pass & Seymour PS20AC4
- E. Provide 20 amp switches for loads exceeding 10 amps.
- F. Use HP rated switches approved for motor control or disconnect service when controlling or disconnecting motor loads in excess of 1/4 HP.

2.2 RECEPTACLES

- A. Duplex receptacle, 20 amp
 - 1. Hubbell HBL5362; Leviton 5362; Pass & Seymour PS5362
- B. Ground fault circuit interrupting (GFCI), tamper resistant, type receptacle, equivalent to Hubbell GFST83W. Provide weather resistant GFCI receptacle for exterior locations. Do not use feed-through feature. Install GFCI device at each location.
- C. Patient Care Areas:

1. Duplex receptacle, 15 amp equivalent to Hubbell HBL8200
2. Duplex receptacle, 20 amp equivalent to Hubbell HBL8300
3. GFCI receptacle, 20 amp equivalent to Hubbell GFR8300TR

2.3 WIRING DEVICES

- A. All wiring devices shall be white wiring devices for normal power circuits. Provide red wiring devices for emergency power circuits.

2.4 COVERPLATES

- A. Interior - white, smooth nylon equivalent to Leviton 80000 Series standard size, 0.220 inch thick. Screw heads shall have color to match plate. Provide red, smooth nylon coverplates for devices connected to emergency power circuits.
- B. Provide blank telephone and data coverplates same as above.
- C. Exterior - extra heavy duty, die cast aluminum, weatherproof while-in-use cover equivalent to Hubbell WP26E series.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Determine from dimensions shown in the Contract Documents and by actual measurements on the site the exact location of each wiring device. The wiring device locations shall be modified from those shown on the plans to accommodate changes in door swings, space changes or to clear other interferences that arise, or from other job modifications. Make such modifications at no cost to the Owner as a matter of job coordination. Notify the Architect of discrepancies before proceeding with the installation of the work.

3.2 INSTALLATION OF WIRING DEVICES

- A. Install receptacles and switches only in electrical boxes that are clean, free from excess building materials, debris, etc.
- B. Switches installed at one location shall be ganged together under one coverplate.
- C. Install receptacles for electric water coolers out of sight where possible.

3.3 TESTING

- A. Test wiring devices to insure electrical continuity of grounding then energize circuit to demonstrate compliance with requirements.

END OF SECTION

**SECTION 262816
OVERCURRENT PROTECTIVE DEVICES**

PART 1 - GENERAL

1.1 SUMMARY

- A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
- B. Furnish all labor, materials, services, equipment appliances required in conjunction with installation of overcurrent protective devices as indicated in the Contract Documents.

1.2 SUBMITTALS

- A. Manufacturer's Data: Submit copies of manufacturer's specifications for products to be used.

PART 2 - PRODUCTS

2.1 FUSES

- A. Fuses shall be current-limiting, with 200,000 RMS symmetrical amperes interrupting rating and shall be UL listed. All fuses shall be of same manufacturer.
- B. Fuses in motor circuits shall be changed, if necessary, as follows: Fuses for not less than 1.15 service factor motors shall have an ampere rating 125 percent of motor full load current or next higher fuse rating. Fuses for 1.0 service factor motors shall have an ampere rating 115 percent of motor full load current or next higher fuse rating. Use special fusing sizing considerations where motors are subjected to high ambient temperatures, where the motor drives an inertia load causing starting current to be prolonged, where on-off cycles less than 30 minutes, or where special hermetically sealed motors have unusual starting characteristics. When a physically smaller fuse is required in a switch, then the fuse clips must be changed.

2.2 MOLDED CASE CIRCUIT BREAKERS

- A. Molded Case Circuit Breaker Characteristics – General
 - 1. Circuit breakers shall be constructed using glass reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
 - 2. Circuit breakers shall have an over center, trip free, toggle operating mechanism which will provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.
 - 3. The circuit breaker handle shall reside in a tripped position between ON and OFF to provide local trip indication. Circuit breaker escutcheon shall be clearly marked ON and OFF in addition to providing International I/O markings.
 - 4. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker.

5. Circuit breakers shall be equipped with UL Listed electrical accessories as noted in these specifications. Circuit breaker handle accessories shall provide provisions for locking handle in the ON and OFF position.
6. All circuit breakers shall be UL Listed for reverse connection without restrictive line and load markings and be suitable for mounting in any position.
7. Circuit breakers shall be equipped with factory installed mechanical lugs. All circuit breakers shall be UL Listed to accept field installable/removable mechanical type lugs (except Square D type Q2, Q2H and Q2-H or equivalent). Lug body shall be bolted in place; snap in design not acceptable. All lugs shall be UL Listed to accept solid (not larger than #8 AWG) and/or stranded copper and aluminum conductors. Lugs shall be suitable for 90°C rated wire, sized according to the 75°C temperature rating in the National Electrical Code. Provide lugs as required to accept feeder conductor sizes and quantities as shown on drawings.
8. All circuit breakers shall be capable of accepting bus connections.
9. Circuit breakers shall be fully rated and capable of interrupting the fault current available to them. Series connected ratings with upstream devices is not acceptable to meet this requirement.
10. Manufacturer shall provide electronic and hard copy time/current characteristic trip curves (and I_p & I^2t let through curves for current limiting circuit breakers) for each type of circuit breaker.

B. Thermal-Magnetic Circuit Breakers

1. Circuit breakers shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole.
2. Thermal trip elements shall be factory preset and sealed. Circuit breakers shall be true RMS sensing and thermally responsive to protect circuit conductor(s) in a 40°C ambient temperature.
3. Circuit breaker frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker except type Square D, Q2, Q2H and Q2-H or equivalent.
4. Standard two- and three-pole circuit breakers up to 250 amperes at 600 VAC shall be UL Listed as HACR type.

C. Equipment Ground Fault Protection (Thermal Magnetic Circuit Breakers)

1. Circuit breakers 250 amperes and less shall be equipped with a Ground Fault Module.
2. Ground fault sensing system shall be modified zero sequence sensing type.
3. The ground fault system shall require no external power to trip the circuit breaker.
4. Companion circuit breaker shall be equipped with a ground-fault shunt trip.
5. The ground fault sensing system shall be suitable for use on grounded systems. The ground fault sensing system shall be suitable for use on three-phase, three-wire circuits

where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems.

6. Ground fault pickup current setting and time delay shall be field adjustable. A switch shall be provided for setting ground fault pickup point. A means to seal the pickup and delay adjustments shall be provided.
7. The ground fault sensing system shall include a ground fault memory circuit to sum the time increments of intermittent arcing ground faults above the pickup point.
8. A means of testing the ground fault system to meet the on-site testing requirements of NEC Section 230-95(c) shall be provided.
9. Local visual ground fault trip indication shall be provided.
10. The ground fault sensing system shall be provided with Zone Selective Interlocking (ZSI) communication capabilities compatible with other thermal magnetic circuit breakers equipped with ground fault sensing, electronic trip circuit breakers with integral ground fault sensing and external ground fault sensing systems as noted on the drawings.
11. The companion circuit breaker shall be capable of being group mounted.
12. The ground fault sensing system shall not affect interrupting rating of the companion circuit breaker.

D. Electronic Trip Circuit Breaker With Full Function Trip System

1. Circuit breaker trip system shall be a microprocessor-based true rms sensing design with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on the associated schedules.
2. The integral trip system shall be independent of any external power source and shall contain no less than industrial grade electronic components.
3. The ampere rating of the circuit breaker shall be determined by the combination of an interchangeable rating plug, the sensor size and the long-time pickup adjustment on the circuit breaker. The sensor size, rating plug and switch adjustments shall be clearly marked on the face of the circuit breaker. Circuit breakers shall be UL Listed to carry 100% of their ampere rating continuously.
4. The following time/current response adjustments shall be provided. Each adjustment shall have discrete settings and shall be independent of all other adjustments.
 - a. Long Time Pickup Instantaneous Pickup
 - b. Long Time Delay Ground Fault Alarm Only Pickup
 - c. Short Time Pickup Ground Fault Pickup
 - d. Short Time Delay (I^2t IN and I^2t OUT) Ground Fault Delay (I^2t IN and I^2t OUT)
5. Circuit breakers with adjustable short-time function shall be provided with defeatable instantaneous adjustment and 30 cycles short time withstand ratings. Short time

withstand ratings shall be specified in RMS symmetrical amperes, as shown on the drawings.

6. A means to seal the rating plug and trip unit adjustments in accordance with NEC Section 240-6(b) shall be provided.
7. Local visual trip indication for overload, short circuit and ground fault trip occurrences shall be provided.
8. An ammeter to individually display all phase currents flowing through the circuit breaker shall be provided. Indication of inherent ground fault current flowing in the system shall be provided on circuit breakers with integral ground fault protection. All current values shall be displayed in True RMS with 2% accuracy.
9. Long Time Pickup indication to signal when loading approaches or exceeds the adjusted ampere rating of the circuit breaker shall be provided.
10. The trip system shall include a Long Time memory circuit to protect against intermittent overcurrent conditions above the long time pickup point. Means shall be provided to reset Long Time memory circuit during primary injection testing.
11. Circuit breaker trip system shall be equipped with an externally accessible test port for use with a Universal Test Set. Disassembly of the circuit breaker shall not be required for testing. Test set shall be capable of verifying the operation of all trip functions with or without tripping the circuit breaker.
12. Communications capabilities for remote monitoring of circuit breaker trip system, to include phase and ground fault currents, pre-trip alarm indication, switch settings, and trip history information shall be provided.
13. Circuit breakers shall be provided with Zone Selective Interlocking (ZSI) communications capabilities on the short-time and ground fault functions compatible with all other electronic trip circuit breakers and external ground fault sensing systems .

E. Equipment Ground Fault Protection (Electronic Trip Circuit Breakers)

1. Circuit breakers shall be provided with integral equipment ground fault protection for grounded systems. The circuit breaker shall be suitable for use on three-phase, three-wire circuits where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems.
2. A separate neutral current transformer shall be provided for three-phase four-wire systems as indicated on schedules and drawings.
3. Ground fault sensing system shall be residual sensing type.
4. The trip system shall include a ground fault memory circuit to sum the time increments of intermittent ground faults above the pickup point.
5. A means of testing the ground fault system to meet the on-site testing requirements of NEC Section 230-95(c) shall be provided.
6. Local visual trip indication for a ground fault trip occurrence shall be provided.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install overcurrent devices in accordance with the National Electrical Code. Coordinate the work under this section with the work under other divisions of the specifications.
- B. Fuses shall be installed in all switches as scheduled or noted on the Drawings, and shall be Bussman, Mersen, Littelfuse, Inc., or an approved equivalent.
- C. Unless otherwise indicated, protective devices shall be mounted with top of cabinet or enclosure 6 ft. 6 in. above finished floor, properly aligned, and adequately supported independently of the connecting raceways. All steel shapes, etc., necessary for the support of the equipment shall be furnished and installed where the building structure is not suitable for mounting the equipment directly thereon.
- D. A fuse identification label showing type and size shall be placed inside the door of each fused switch.
- E. Circuit breaker pick-up level and time delay settings shall be adjusted to values as instructed by the Engineer.

END OF SECTION

**SECTION 262817
DISCONNECT SWITCHES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
- B. Furnish all labor, materials, services, equipment and appliances required in conjunction with installation of disconnect switches as indicated in the Contract Documents.

1.2 SUBMITTALS

- A. Manufacturer's Data: Submit copies of manufacturer's specifications for products to be used.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Furnish fusible Class 'R' or non-fusible disconnect switches of ampere rating as required, or as indicated on the Drawings. Furnish heavy-duty, quick-make, quick-break, three-phase, three-pole switches, unless otherwise noted. Use NEMA 1 enclosures where installed indoors. Use NEMA 3R for outdoor enclosures. Provide enclosures with interlocking covers, externally front operated flange mounted switch levers, and provisions for use of three safety padlocks in the 'Off' position. Provide horsepower rated switches for motor circuits. Disconnect switches shall be of the same manufacturer as the panelboards.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK paragraph: Identification of Electrical Equipment.
- B. Install switches to comply with National Electrical Code and coordinate the work with the work under other divisions of the specifications.

END OF SECTION

SECTION 262913
MOTORS, MOTOR STARTERS AND CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
- B. Furnish all labor, materials, services, equipment and appliances required in conjunction with installation of motors, motor starters and controls as indicated in the Contract Documents.

1.2 SUBMITTALS

- A. Manufacturer's Data: Submit copies of manufacturer's specifications for products to be used.

1.3 ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

- A. Electrical wiring for mechanical equipment is separated into two main wiring Divisions: "Power Wiring" and "Control Wiring".
- B. Power wiring is wiring and conduit from the primary energy source and includes circuit protective devices, motor starters or controllers, conduit, wiring and safety disconnects beginning at the power supply and terminating at the motor terminals on equipment.
- C. Control wiring is wiring and conduit not included in "Power Wiring", including automatic temperature control wiring, interlock wiring, pilot light, signal wiring, etc., that is included for proper operation or safety of the equipment.
- D. Provide power wiring under Division 26 of this specification.
- E. Control wiring will be provided under Division 23 of this specification.
- F. Refer to Section 260512 - MECHANICAL AND ELECTRICAL COORDINATION, for directions concerning coordination of the work between Divisions 23 and 26. Coordinate the work under this section with the work under other divisions of the specifications.
- G. Install power and control wiring in compliance with National Electrical Code and this Division.
- H. Disconnect switches, except where furnished factory mounted, shall be supplied and installed by the Electrical Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Unless otherwise specified or required, control conductors with a potential of 120 volts or higher shall be a minimum of #14 THWN stranded, and control conductors with a potential of less than 120 volts may be #16 TFFN, unless larger conductors are required to compensate for voltage drop.
- B. Install control wiring in a separate conduit raceway system.
- C. Color code conductors to coordinate with wiring schematics and diagrams.

- D. Other materials shall be as specified in other sections of the specifications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Note that the electrical design and drawings are based upon equipment furnished under other divisions of the specifications as indicated in the Contract Documents. Should any equipment change dictate changes to the electrical design the required changes shall be made at no additional cost to the Owner.
- B. Verify the electrical capacities of all motors and electrical equipment furnished by other Divisions and install wiring and equipment as required to completely connect all equipment.
- C. Where possible, terminate conduits in conduit boxes on motors. Where motors are not provided with conduit boxes, terminate the conduits in conduit fittings at the motors.
- D. Where disconnect switches are not provided integral with the control equipment for motors, provide disconnect switches required by these Specifications and the NEC. Generally, disconnect switches shall be heavy-duty, enclosed, externally operable, horsepower-rated switches. Each disconnect switch shall be installed where shown on the Drawings or as close as possible to the motor. Each disconnect switch shall be within sight of its associated controller.

3.2 OVERCURRENT PROTECTION

- A. Prior to providing power to equipment, obtain manufacturer's engineering and electrical data.
- B. Provide overcurrent protection of equipment in strict accordance with manufacturer's maximum recommendations and specifications. Provide HACR circuit breakers and fuses in accordance with manufacturer's recommendations and specifications.
- C. Install wiring in a separate conduit raceway system in harmony with other raceway systems on the project.
- D. Install starters, not furnished within a motor control center on a 3/4 in. thick marine plywood backboard painted to match the surrounding area. Apply a minimum of two coats of paint. Install control and/or accessory devices on the backboard also, in mechanical equipment areas.

3.3 ELECTRICAL CONNECTIONS

- A. Provide electrical connections to each item of equipment requiring such connections.

3.4 EQUIPMENT IDENTIFICATION

- A. Identify starters, switches, pushbuttons and other control devices by the attachment of nameplates constructed from laminated phenolic engraved plastic three-ply with black surface and white interior core at least 1/16 in. thick. Engraved lettering shall use an Arial bold font at least 1/4 in. high and properly spaced for legible and easy reading. Attach plates to equipment with chromium-plated screws. Adhesive attachment is not acceptable.

END OF SECTION

**SECTION 265113
LIGHTING**

PART 1 - GENERAL

1.1 SUMMARY

- A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
- B. Furnish all labor, materials, services, equipment and appliances required in conjunction with the installation of a lighting system as indicated in the Contract Documents.

1.2 SUBMITTALS

- A. Manufacturer's Data: Submit copies of fixture, ballast and lamp manufacturer's specifications for products used. Identify the total input watts including ballast losses for each fixture type.
- B. Submit lighting facts documentation for all LED fixtures.
- C. If required by Architect, submit samples of lighting fixtures for approval.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Lighting Fixtures: See Schedule in Contract Documents.
- B. Where fixtures are subject to moisture, provide damp location (DL) or wet location (WL) label on fixtures as required for the location.

2.2 LED FIXTURES

- A. Shall be tested for adherence to IESNA LM79 standards for lumen output and depreciation.
- B. Shall be tested to IESNA LM80 standards and shall be rated to deliver LM80 performance for 50,000 hours.
- C. Shall be DLC (DesignLight Consortium) certified.
- D. Shall be equipped with 0-10 volt dimming driver.
- E. Shall carry a 5 year all-inclusive component warranty for defects.

2.3 EXIT LIGHTS

- A. Furnish and install exit lights as indicated in the Contract Documents.
- B. Provide single or double face unit as required for each location with arrows as required to clearly define the path of egress, whether shown on the drawings or not. Provide battery powered exit lights, for ninety minute duration, if exit lights are not served with an emergency power source.
- C. Locate fixtures on the ceiling or wall as required by the Architect.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide lighting fixtures as specified and scheduled in the Contract Documents. Provide in accordance with the type designation shown in the Contract Documents. If a type designation is omitted, verify fixture selection with Architect prior to installation.
- B. Check the architectural finishes, and provide fixtures with proper trim, frames, supports hangers, and other hardware as required to coordinate with proper finishes, regardless of specified or scheduled catalog number, prefixes and suffixes.
- C. Coordinate with Division 23 and other divisions of the specifications to avoid conflicts between lighting fixtures, supports and fittings and mechanical equipment and other work.
- D. Fixtures, which are tandem mounted and recessed in gypboard or plaster ceilings shall be yoke mounted.
- E. Immediately before final inspection, clean all fixtures, inside and out, including plastics and glassware, adjust all trim to properly fit adjacent surface, replace broken or damaged parts. Test all fixtures for electrical as well as mechanical operation.

END OF SECTION

**SECTION 270528
EMPTY CONDUIT SYSTEMS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
- B. Furnish all labor, materials, services, equipment and appliances required in conjunction with the installation of empty conduit systems for telephone, computer communication and other systems as indicated in the Contract Documents.

1.2 SUBMITTALS

- A. Manufacturer's Data: Submit copies of manufacturer's specifications for products used.

PART 2 - PRODUCT

2.1 MATERIAL

- A. Provide cabinets as specified elsewhere in the specifications. Furnish total metal unit with enclosure, hinged door, lock with two keys and installed with 3/4 in. thick plywood in back.
- B. Provide 3/4 in. thick marine plywood painted with one coat of primer and two coats of latex enamel to match surroundings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide a 1 in. conduit from each telephone, data or combination telephone/data outlet to the accessible ceiling space above unless noted otherwise. Turn the conduit horizontal, provide a pull string in the conduit and a plastic bushing on the conduit end.
- B. Install pull wire in all empty conduits or conduit systems. Label pull wire indicating the location of the other end.
- C. Coordinate the work in this section with the work under other divisions of the specifications.

END OF SECTION